

THE RISK-BASED CAPITAL SIMULATION
APPLICATION
USER MANUAL



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1. INTRODUCTION

1.1 About This Manual

1.1.1 Audience

This manual is intended for users of the Risk-Based Capital (RBC) Simulation Application. Users should have intermediate level UNIX, SAS, and Sybase SQL experience.

1.1.2 Manual Overview

This manual describes the procedures required to configure and execute a RBCSIM application run.

1.1.3 Additional Documentation

In addition to this manual, the RBCSIM application includes the following printed and on-line documentation:

- The Risk-Based Capital Simulation Application Installation Manual.
- The Risk-Based Capital Simulation Application User Manual.
- The Risk-Based Capital Report Instructions.
- The Risk-Based Capital Stylized Data Set Overview.
- OFHEO Phase 2 Business Rules.
- CreditEnhancementContract-Phase3.
- MultifamilyBusinessRules-Phase3.
- NMI Business Rules-Phase3.
- SingleClassMBSBusRules-Phase3.
- SingleFamilyBusinessRules-Phase3.
- Additional documentation is available at the official OFHEO web site: <http://www.ofheo.gov>.

1.1.4 Contact Point

All questions regarding the RBCSIM application should be emailed to: rbcquestions@ofheo.gov.

1.2 About OFHEO

The Housing and Community Development Act of 1992, under Title XIII, the Federal Housing Enterprises Financial Safety and Soundness Act of 1992, established the Office of Federal Housing Enterprise Oversight (OFHEO). The primary function of the Office is to perform financial regulation of Fannie Mae and Freddie Mac (collectively referred to as the “Enterprises”) to ensure that the Enterprises are adequately capitalized and operating safely, in accordance with the Act.

1.2.1 OFHEO's Mission

OFHEO was required by the Federal Housing Enterprises Financial Safety and Soundness Act of 1992 (1992 Act) to establish minimum and risk-based capital standards as part of its role as safety and soundness regulator. These capital requirements are intended to ensure both Enterprises continue to operate and perform their crucial roles in the secondary mortgage market, keeping constant the flow of funds to mortgage lenders and prospective American homeowners. By ensuring the Enterprises are adequately capitalized, OFHEO minimizes the risk that American taxpayers will ever be asked to pay for losses at these complex financial institutions.

OFHEO evaluates capital adequacy from other perspectives as well. OFHEO's **examination program** conducts continuous, comprehensive examinations of the Enterprises to ensure they are operating under standards of financial safety and soundness. OFHEO's examination of the Enterprises provide a qualitative assessment of capital adequacy. The more direct and quantitative tools are OFHEO's **minimum** and **risk-based capital** standards, which are supplemented with other tests and analyses. OFHEO's minimum capital standard is calculated based on specific percentages for assets and off-balance sheet guarantees. The minimum capital level is therefore determined more by the size of the Enterprise than its specific risks. The risk-based standard, in contrast, requires that Fannie Mae and Freddie Mac each have enough capital to survive prolonged, severe problems in financial and economic markets, as well as management or operational failures. It is directly related to the risks the Enterprises are exposed to in their current business.

1.2.2 The Risk-Based Capital Rule

The risk-based capital regulation meets the specific requirements of the 1992 Act. The rule utilizes a stress test to determine the amount of capital needed to protect against credit and interest rate risks, and requires 30 percent additional capital to protect against unspecified management and operations risk. The regulation itself is the blueprint needed to construct the stress test and calculate the risk-based capital requirement for Freddie Mac and Fannie Mae. It is a detailed description of the stress test allowing the Enterprises and others to essentially replicate the stress test, as required by law.

What is the Stress Test?

OFHEO's risk-based capital standard is based on a 10-year stress test. A stress test measures risk in the context of a company's overall portfolio, including the effectiveness of a company's risk management strategies. While companies often use stress tests for internal risk management, and rating agencies use stress tests to rate companies and securities, OFHEO is among the first financial institution regulators to use its own stress test to determine capital

adequacy.

OFHEO's stress test simulates an Enterprise's financial performance over a 10-year period under severe economic conditions. Key aspects of the severe economic conditions used in OFHEO's stress test are defined in the 1992 Act and further specified in OFHEO's risk-based capital regulation. These conditions include high levels of mortgage defaults, with associated losses and large, sustained movements in interest rates, both increasing (up-rate scenario) and decreasing (down-rate scenario).

OFHEO uses a detailed computer model to simulate each Enterprise's cash flows associated with mortgages and other financial assets and obligations under the severe economic conditions of the stress test. The modeling of incoming and outgoing cash flows captures the risks embedded in those financial assets and obligations and the benefits of the hedges each Enterprise has set in place. To meet OFHEO's risk-based capital standard, each Enterprise must have sufficient capital to support any losses generated under these severe economic conditions plus an additional 30 percent for unspecified management and operations risks. The result is a stringent test of the capital adequacy of each Enterprise.

1.3 Software Identification

RBCSIM 10/31/2007 Release.

2. SOFTWARE SUMMARY

2.1 Software Application Summary

The RBCSIM Software is composed of two subsystems: the data validation system and the simulation model. Both subsystems use a Sybase database for storing input data and final results.

2.1.1 Data Validation System

The Data Validation System (DVS) performs a variety of checks to ensure the input data is model ready. The DVS checks for referential integrity, compliance with allowable values and the internal consistency of the fields comprising each record using a variety of 'business rules'. As the simulation model performs a limited set of data quality checks, it is very important that new data sets are validated prior to running them through the simulation model. Running the simulation model with data that has not been validated may result in inaccurate results or application instability.

The DVS is implemented using a combination of Perl and SAS scripts and Sybase stored procedures. Information on installing and configuring the DVS can be found in section 4.2 of the *Risk-Based Capital Simulation Application Installation Manual*. Information on running the DVS can be found in section 3.1 of this document.

2.1.2 Simulation Model

The simulation model calculates the RBC Capital Requirement. The model is composed of three modules that project cash flows and a module that performs accounting, tax, investment, funding, financial reporting and capital calculations. All of the modules are implemented in C++ and are executed from the command line using a set of configuration files. These configuration files contain both application configuration information as well as policy parameters. More information on the individual modules follows:

Whole Loan Cash Flow. The Whole Loan Cash Flow (WLCF) module projects cash flows for retained and sold whole loans as well as for commitments. The WLCF reads information from the configuration file and input data from the database, performs amortization, default and prepayment calculations and writes its output to a text file as projected cash flows. Sections 3.2 and 3.6 of the RBC Rule provide a detailed discussion of the calculations performed by the WLCF module. The WLCF operates in two modes. One mode produces cash flows for retained and sold whole loans (WLCF); the other mode produces cash flows for commitments (CMT).

Mortgage Related Securities. The Mortgage Related Securities (MRS) module projects cash flows for single class MBS, Mortgage Revenue Bonds (MRBs) and multi-class MBS (e.g. REMICs, Strips, etc.). The MRS module uses the proprietary Intex Solutions, Inc. Application Programming Interface (API) to project the cash flows for multi-class MBS. The MRS reads information from the configuration file and input data from the database, performs amortization, default and prepayment calculations and writes its output to a text file as projected cash flows. Section 3.7 of the RBC Rule provides a detailed discussion of the calculations performed by the MRS module. The MRS operates in three modes. One mode produces cash flows for single class MBS (MBS), the second mode produces cash flows for MRBs (MRB) and the third mode produces cash flows for multi-class MBS (REMIC).

Non-Mortgage Instruments. The Non-Mortgage Instruments (NMI) module projects cash flows for debt instruments, non-mortgage related investments, guaranteed investment contracts, preferred stock, and derivative contracts. The NMI module also performs the Alternative Modeling Treatment (AMT)

calculations. The NMI module uses the proprietary Intex Solutions, Inc. API to project the cash flows for non-mortgage-related ABS (e.g. auto loan deals, credit card deals, etc.). The NMI module reads information from the configuration file and input data from the database, performs financial calculations and writes its output to a text file as projected cash flows. Sections 3.8 and 3.9 of the RBC Rule provide a detailed discussion of the calculations performed by the NMI module. The NMI operates in three modes. One mode produces cash flows for Futures (FUT), the second mode produces cash flows for items subject to AMT (AMT), and the third mode produces cash flows for all other instruments (NMI).

Reporting and Decisions Module. The Reporting and Decisions Module (RDM) implements the accounting, tax, investment, funding, financial reporting and capital calculation processes. The RDM module reads information from the configuration file, input data from the database, and the output files from the three cash flow modules, performs financial and accounting calculations and writes output to the database. Sections 3.10 and 3.12 of the RBC Rule provide a detailed discussion of the calculations performed by the RDM module.

Information on installing and configuring the simulation module can be found in section 4.2 of the *Risk-Based Capital Simulation Application Installation Manual*. Information on running the simulation model can be found in section 3.2 of this document.

2.2 RBC Application Workflow

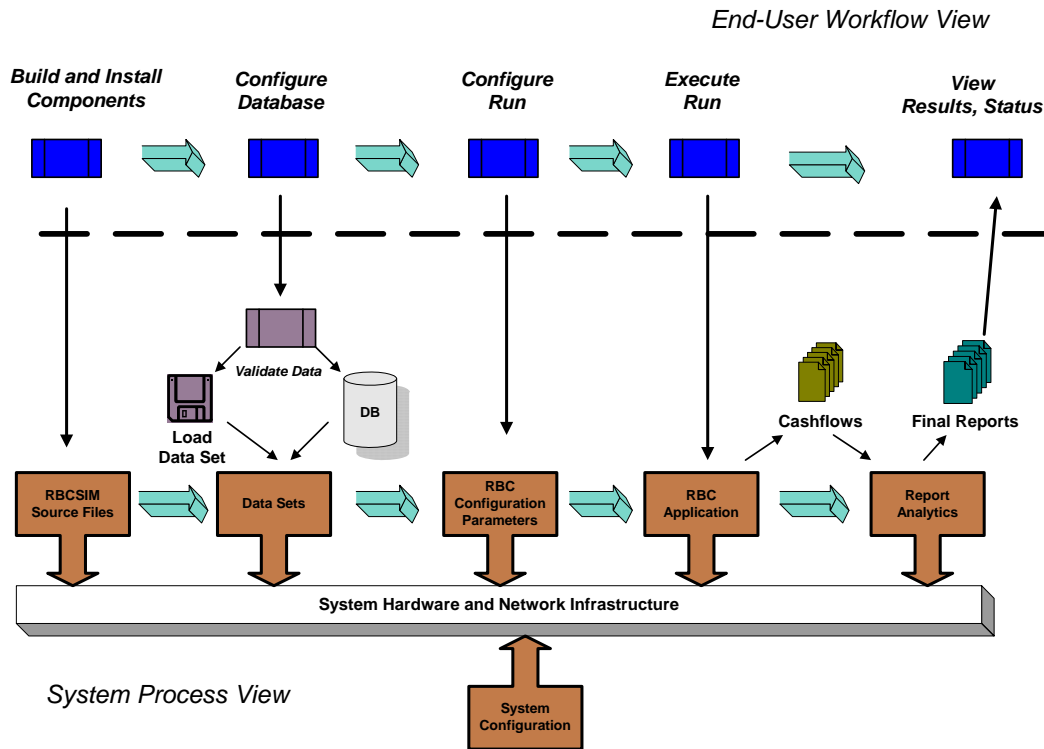


Figure 2-1: RBCSIM Workflow

2.3 RBC Application Rule Information Flow

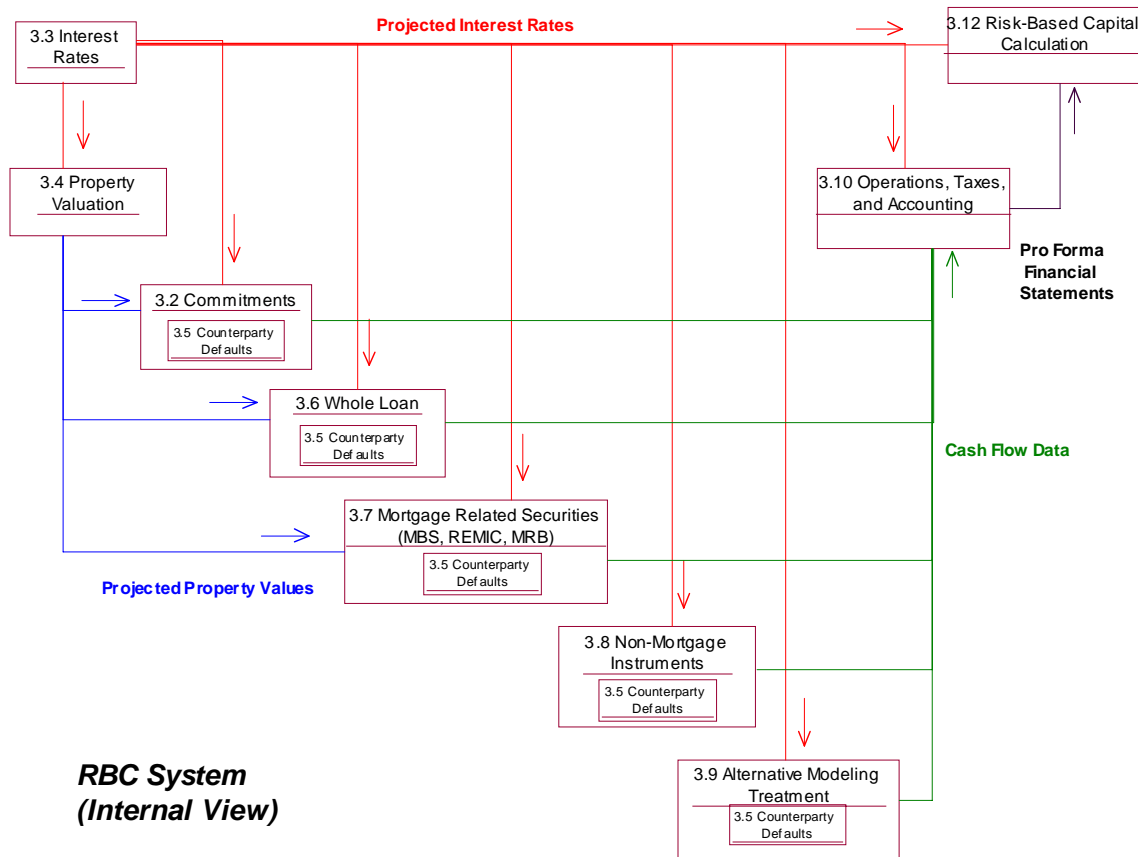


Figure 2-2: Information Flow Between Rule Sections

3. APPLICATION OPERATION

3.1 Application Run Configuration

This section discusses the steps needed to validate a data set for use in the model and to configure global paths and defaults.

3.1.1 Create, Set-up and Populate the RBCSIM/Data Validation Database

Reference *The Risk-Based Capital Simulation Application Installation Manual*, Sections 4.2.2 and 4.2.3 for creating, setting-up and populating the RBCSIM/Data Validation database. This database must exist with source data prior to performing the data validation described in Section 3.1.2.

3.1.2 Running RBC Data Validation System

Before the application is run against a new data set, the data needs to be validated to ensure it meets the requirements of the application. Running the application against data that has not passed all of the validation tests may result in inaccurate results or application instability.

The data validation process only needs to be executed when a new data set is being prepared for use in the model – it does not need to be executed every time the model is run. Specify the RBCSIM/Data Validation database and server referenced in Section 3.1.1 above and a user id that has been granted access to the data tables and stored procedures when executing the steps below.

These instructions are written for an individual with intermediate level SAS and Sybase SQL experience.

3.1.2.1 Data File and Column Level Validation

The purpose of this validation phase is to ensure the values reported for each data element conform to the allowable values and to check the raw data files for control characters and unwanted spaces. See the *RBC Report Instructions* for more information on allowable values.

Note: the scripts and procedures referenced below are hard-coded for the stylized data set and will need to be modified to validate other data sets. See the *Risk-Based Capital Stylized Data Set Overview* for more information on the stylized data set.

Step 1: Check the raw data files for control characters/unwanted blanks.

- a. Set the UNIX environment variable `$RBC_HOME`. The exact location of the script will vary depending on the installation procedures. (See figure 4-1 in the *Risk-Based Capital Simulation Application Installation Manual* for reference.)
 - **command:** `source ../../RBCSIM-B20030131-V1.0/config/rbcenv.csh` (C shell)
 - **command:** `. ../../RBCSIM-B20030131-V1.0/config/rbcenv.bash` (Korn or Bash shells)
- b. Navigate to the directory containing the raw data files
command: `cd $RBC_HOME/db/data/Acme`
- c. Execute script `scan_data.pl`
command: `perl $RBC_HOME/db/data_validation_system/bin/scan_data.pl`
- d. Files listed after execution contains control characters/unwanted blanks. Remove control characters/unwanted blanks from affected data file(s) and run again.

- e. File *log.fil* is created containing all of the files that were checked. If validating the stylized data, compare file *log.fil* with the file specified below for verification. The contents of the files should match.
 - *log.fil* - *\$RBC_HOME/db/data_validation_system/output/log_fil_example.txt*.
- f. Navigate back to the data validation source directory and continue
command: `cd $RBC_HOME/db/data_validation_system/bin`

Step 2: Check Loan-Group Data Files.

- a. using a text editor, update program *main_ffo.sas* with the following information:
 - Sybase connection information in the *libname* statement. The position to enter this information is specified in the SAS program. Specify the database and server used in Section 4.2.2, Step 1 of the *Risk-Based Capital Simulation Application Installation Manual*. The user id/password from this section may also be used.
 - Runtime parameters. The position to enter this information is specified in the SAS program. Parameters include Enterprise abbreviation, the report date, the date the data was prepared and a relevant comment (optional).
 - Location of the SAS Format library. The position to enter this information is specified in the SAS program. Specify the SAS Format Library created in Section 4.2.3, Step 5 of the *Risk-Based Capital Simulation Application Installation Manual*.
 - Location and name of data file(s). The position to enter this information is specified in the SAS program.
- b. Execute the *main_ffo.sas* SAS program.
command: `/<SAS directory>/sas main_ffo.sas`
- c. If validating the stylized data, compare file *main_ffo.log* created in step b. above with the example file specified below for verification. The contents of the files should match with the possible exception of the location of the SAS library and SAS generated messages.
 - *main_ffo.log* - *\$RBC_HOME/db/data_validation_system/output/main_ffo_example.txt*
- d. (Optional) using a text editor, open file *main_ffo.lst* created in step b. to review the data validation results. This file will not be created when using the stylized data as it is only created in the event validation violations are found. This information can also be queried from the Sybase data tables.

Notes:

- The validation checks are done on all the RBC Report pipe-delimited data files at one time. If no data file exists for a given data table, create and specify a data file that has no rows in it.
- It is possible to run the loan-group validations without writing the rows to the data validation tables. To do this, perform the following procedure:
 - In the *main_ffo.sas* SAS program, comment out the *libname* statement in the beginning of the program and the *%violation* macro invocation at the end of the program.
- It is possible to run the loan-group validations without producing the default SAS validation report. To do this, perform the following procedure:
 - In the *main_ffo.sas* SAS program, comment out the *%do_report* macro invocation at the end of the program.

3.1.2.2 Primary Key, Referential Integrity Checks, and Business Rule Checks

The purpose of this validation phase is to perform primary key, referential integrity and business rule validation checks. The business rule checks validate the internal consistency of the records. For example, the mortgage payment field is examined for consistency with the UPB, term and coupon fields.

See the following documents for more information: *OFHEO Phase 2 Business Rules.pdf*, *CreditEnhancementContract-Phase3.pdf*, *MultifamilyBusinessRules-Phase3.pdf*, *NMI Business Rules-Phase3.pdf*, *SingleClassMBSBusRules-Phase3.pdf* and *SingleFamilyBusinessRules-Phase3.pdf*.

- a. **Note:** If the environment variable *\$RBC_HOME* was already set in Section 3.1.2.1, Step 1.a, the following command does not need to be executed and you may proceed to Step b.

Create the UNIX environment variable *\$RBC_HOME*. The exact location of the script will vary depending the installation, but may be found in the following sub-directories.

- **command:** `source ../rbcsim/config/rbcenv.csh` (C shell)
- **command:** `.../rbcsim/config/rbcenv.bash` (Korn or Bash shells)

- b. Navigate to the directory *\$RBC_HOME/db/data_validation_system/bin*
command: `cd $RBC_HOME/db/ data_validation/bin`

- c. Using a text editor, update script *DVS_run_data_checks.sql* with run-time parameters and save. The position to enter this information is contained in the script. Parameters include Enterprise abbreviation, the report date, the date the data was prepared and a relevant comment (optional).

- d. Execute script *DVS_run_data_checks.sql*.

command: `isql -S<server_name> -i DVS_run_data_checks.sql -o <output filename> -U<user id> -P<password> -D<database> -e`

Notes: 1. Specify the database and server used in Section 4.2.2, Step 1 of the *Risk-Based Capital Simulation Application Installation Manual*. The user id/password from this section may also be used.

- e. Compare file *<output filename>* created in step d. above with the example file specified below for verification. The contents of the files should match.

- *Output filename - \$RBC_HOME/db/ data_validation /output/ DVS_run_data_checks_example.txt*

3.1.2.3 Validation Report

Follow the instructions below to run the data validation report. The validation report for the stylized data set should not show any violations.

- a. **Note:** If the environment variable *\$RBC_HOME* was already set in Section 3.1.2.1, Step 1.a, the following command does not need to be executed and you may proceed to Step b.

Create the UNIX environment variable *\$RBC_HOME*. The exact location of the script will vary depending the installation, but may be found in the following sub-directories.

- **command:** `source ../rbcsim/config/rbcenv.csh` (C shell)
- **command:** `.../rbcsim/config/rbcenv.bash` (Korn or Bash shells)

- b. Navigate to the directory *\$RBC_HOME/db/data_validation /bin*
command: `cd $RBC_HOME/db/data_validation_system/bin`

- c. Using a text editor, update script *DVS_run_validation_report.sql* with run-time parameters and save. The position to enter this information is contained in the script. Parameters include Enterprise abbreviation, the report date, the date the data was prepared and the date the data validation was executed.
- d. Execute script *DVS_run_validation_report.sql*.
command: `isql -S<server_name> -i DVS_run_validation_report.sql -o <output filename> -U<user id> -P<password> -D<database> -e`
Notes:
 1. Specify the database and server used in Section 4.2.2, Step 1 of the *Risk-Based Capital Simulation Application Installation Manual*. The user id/password from this section may also be used.
 2. alternatively, you may execute script *DVS_run_val_upb_report.sql* to get an instrument-level validation report containing the UPB amount.
- e. The validation report for the stylized data set should not show any violations. The file specified below is an example of a report containing validation violations.
 - `$RBC_HOME/db/data_validation_system/output/DVS_run_val_report_example.txt`

3.1.3 Configure RBC Runtime Components

3.1.3.1 Run-time Configuration and Policy Parameters

The run-time configuration parameters are set through a text based configuration file (Ref: [Appendix B](#)). This file allows the specific characteristics of a run to be set by specifying parameter key and value pairs. The value can contain an environment variable in the form of `${VAR}` that is substituted for at run-time. If a string value requires embedded spaces, the value must be in quotes. Comments, semi-colons, can be embedded anywhere in the file. Everything following the semi-colon (on the specific line) is ignored.

The full set of configuration parameters are listed in Table 3-1. Each parameter is either required or optional. Required parameters are needed for a full RBC run and must be in the configuration file. Optional parameters enable additional debugging/analysis capabilities.

Prior to running the application, ensure that the desired run-time configuration parameters are set.

Table 3-1: RBC-SIM Parameters

Key	Values {Value Set} Default	Module	Purpose	Required
altLogFile	{path/filename} /tmp/rbcdump.txt	COMMON	If an output exception occurs, dump the messages in this file.	No
catchFatalSignals	{true,false} true	COMMON	Signal Handler catches exceptions, and then aborts.	No
logDirectory	{path/name}	RDM, COMMON	Reference RDM.	Yes
LogLevel	{0,1,2,3,4} 1	COMMON	Determines which level messages are printed to log. Debug = 0, Info = 1, Warning = 2, Error = 3, Fatal = 4.	Yes
LogAppendFlag	{true, false} false	COMMON	Determines whether to append to the existing log files or overwrite them.	Yes
databaseName	None	COMMON	Target database.	Yes
databaseServer	None	COMMON	Sybase server.	Yes
description	{any string} empty	COMMON	Run description.	No
fpeLimit	{0-n} 1000	COMMON	Number of floating point exceptions allowed before application aborts.	No
enterpriseName	Acme	COMMON	Name of organization for a specific run.	Yes

Key	Values {Value Set} Default	Module	Purpose	Required
intexDataCDI	{path/directory name} ex: /data/intex_0425 02/cdi	COMMON	Location of Intex deal description files.	No, (Yes for NMI and MRS modules)
intexDataCDU	{path/directory name} ex: /data/intex_0425 02/cdu	COMMON	Location of Intex deal update files.	No, (Yes for NMI and MRS modules)
rptQuarter	{1-4} 1	COMMON	Reporting quarter for data submission.	Yes
rptYear	2002	COMMON	Reporting year for data submission.	Yes
scenario	{up, down} up	COMMON	Direction of interest rate projection.	Yes
useInstmIds	{true, false} false	ALL (WLCF, NMI...)	Run with a subset of instrument IDs.	No
instmIdList	Ex: ('####', '####', '####')	ALL	Run with a subset of instrument IDs.	No, (Yes if useInstmIds is set to true.)
version	{any string} empty	COMMON	Description of software version.	No
calcIR	{true, false} true	IRPV	true: calculate interest rate based on current historical data. false: query existing interest rate projections using supplied profile name provided in profileName key.	Yes
calcPV	{true, false} true	IRPV	true : calculate property valuation based on current historical data. false : query existing property valuation projections using supplied profile name provided in profileName key	Yes
entBorrowingBasicPct	0.001	IRPV	Number of basis points (expressed as a decimal) added to the Federal Agency Cost of Funds rates to derive the Enterprise Cost of Funds rates for the last 108 months of the Stress Test. See section 3.3.1[b] of the RBC Rule.	No
intrRateInterpolate	{true, false} true	IRPV	false : ignore calculation/query interpolated interest rates. true : include calculation/query interpolated interest rates.	Yes
mrtgBasicPct	0.005	IRPV	Number of basis points (expressed as a decimal) added to the 30-year Conventional Mortgage Rate to derive the 7-year Balloon Mortgage Rate.	No
profileName	None	IRPV	Used to identify projected interest rates in the database.	No, unless calcIrPv is off or if saveIR2Db is on
saveIR2Db	{true, false} false	IRPV	true : save interest rate to database. false: don't save interest rate to database.	Yes

Key	Values {Value Set} Default	Module	Purpose	Required
saveIR2File	{true, false} false	IRPV	true : save interest rate to file. false : don't save interest rate to file.	Yes
savePV2Db	{true, false} false	IRPV	on : save property valuation to database. off : don't save property valuation to database.	Yes
savePV2File	{true, false} false	IRPV	on : save property valuation to file. off : don't save property valuation to file.	Yes
treasury160Pct	1.6	IRPV	Up rate shift, expressed as a multiple of the average of the ten-year CMT for the 36 months prior to the start of the stress test. See section 3.3.3[a]1.b.2 of the RBC Rule.	No
treasury175Pct	1.75	IRPV	Up rate shift cap, expressed as a multiple of the average of the ten-year CMT for the nine months prior to the start of the stress test. See section 3.3.3[a]1.b of the RBC Rule.	No
treasury50Pct	0.5	IRPV	Down rate shift floor, expressed as a multiple of the average of the ten-year CMT for the nine months prior to the start of the stress test. See section 3.3.3[a].1 of the RBC Rule.	No
treasury60Pct	0.6	IRPV	Down rate shift, expressed as a multiple of the average of the ten-year CMT for the 36 months prior to the start of the stress test. See section 3.3.3[a]1.a.2 of the RBC Rule.	No
treasuryBasicPct	0.06	IRPV	Ten-year CMT shift, expressed as a decimal which is added to (up rate scenario) or subtracted from (down rate scenario) the ten-year CMT for the nine months prior to the start of the stress test. See sections 3.3.3[a]1.a.1 and 3.3.3[a]1.b.1 of the RBC Rule.	No
aggregateByCusip	{true, false}	MRS	Aggregate final cash flows at the cusip level instead of the default, which is aggregation by ledger code.	Yes
intermediateValue	{true, false} false	MRS	Write intermediate calculation values to a file. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i>	Yes
intexDataFile	{path/filename}	MRS	File containing non-public security structures. Mandatory if the intexDataSupplied key is true.	No, unless intexDataSupplied is true
intexDataSupplied	{true, false}	MRS	True if non-public offering structures are included in the Intex database.	Yes
mbsCashflowFileName	{path/filename}	MRS	File name for MBS cash flows. Path must specify the full path to the target result set.	Yes
mrbcashflowFileName	{path/filename}	MRS	File name for MRB cash flows. Path must specify the full path to the target result set.	Yes
remicCashflowFileName	{path/filename}	MRS	File name for REMIC cash flows. Path must specify the full path to the target result set.	Yes
amtCashflowFileName	{path/filename}	NMI	File name for AMT cash flows. Path must specify the full path to the target result set.	Yes
futureCashflowFileName	{path/filename}	NMI	File name for futures cash flows. Path must specify	Yes

Key	Values {Value Set} Default	Module	Purpose	Required
			the full path to the target result set.	
nmiCashflowFileName	{path/filename}	NMI	File name for NMI cash flows. Path must specify the full path to the target result set.	Yes
NMIDatabaseName	{Database Name} <i>ex: nmi_far</i>	NMI	If a value is supplied for this key then the NMI module will pull the securities data from this database instead of the value in databaseName.	
adminExpenseMethod	{1, 2}	RDM	Obsolete.	Yes
batch	{true, false} false	RDM	true = executable run in batch mode. false = executable run in GUI mode.	Yes
cashflowFileName	{path/filename} <i>ex: combined.CF</i>	RDM	<i>Path/filename</i> of combined cashflow file to be created from the cash flow files generated by the WLCF, MRS, and NMI modules. Path must specify the full path to the target result set.	Yes
effectiveTaxRate	30.0	RDM	Effective Tax Rate. See section 3.10.3.5[b] of the RBC Rule.	Yes
endMonth	120	RDM	Total months in the stress period.	Yes
newRunProfileName		RDM	Name of the new database run profile to be created for this run. If a runProfileName parameter is provided, the following parameters will be ignored in the configuration file and taken from the database instead: adminExpenseMethod, cashflowFileName, description, effectiveTaxRate, enterpriseName, rptQuarter, rptYear.	Yes, if no runProfileName parameter provided. No, if runProfileName parameter is provided.
overWrite	{true, false} false	RDM	true = overwrite the financial reports stored in the database for the profile identified by the runProfileName parameter. false = do not overwrite the financial reports stored in the database for the profile identified by the runProfileName parameter. *NOTE: This parameter is checked only if no newRunProfileName parameter is supplied.	Yes
ReportProfileLowerBound2	8	RDM	Obsolete.	Yes
ReportProfileLowerBound3	9	RDM	Obsolete.	Yes
ReportProfileLowerBound4	10	RDM	Obsolete.	Yes
ReportProfileLowerBound5	11	RDM	Obsolete.	Yes
ReportProfileLowerBound6	12	RDM	Obsolete.	Yes
ReportProfilePeriod	{A, M, B}	RDM	The period for which reports are to be generated. A = annual M = monthly	Yes

Key	Values {Value Set} Default	Module	Purpose	Required
			B = both	
runProfileName		RDM	Name of an existing database run profile which will be the basis of the new run.	Yes, if newRunProfileName parameter provided. No default. No, if newRunProfileName parameter provided.
sqrOutputDirectory	{path/directory}	RDM	Path/directory name where the RDM reports are to be placed.	Yes
sqrSourceDirectory	{path/directory}	RDM	Path/directory name where the RDM .sqr files reside.	Yes
aaaCoeff	0.035	WLCF/CMT	Maximum haircut for non-derivative contract counterparties or instruments rated AAA. See Table 3-31 of the RBC Rule.	No
aaCoeff	0.0875	WLCF/CMT	Maximum haircut for non-derivative contract counterparties or instruments rated AA. See Table 3-31 of the RBC Rule.	No
aCoeff	0.14	WLCF/CMT	Maximum haircut for non-derivative contract counterparties or instruments rated A. See Table 3-31 of the RBC Rule.	No
ageCoeff	0.5256	WLCF/CMT	Multifamily Default Equation Age Coefficient. See Table 3-39 of RBC Rule.	No
ageSquaredCoeff	-0.0284	WLCF/CMT	Multifamily Default Equation Age Squared Coefficient. See Table 3-39 of RBC Rule.	No
aggregateByLedgerCode	{true, false} true	WLCF/CMT	Aggregate cash flow based on ledger code.	Yes
aggregateByLoanGroup	{true, false} false	WLCF/CMT	Aggregate cash flow based on loan group.	No
aggregateByLtvRange	{true, false} false	WLCF/CMT	Aggregate cash flow based on ltv range.	No
aggregateByProductCode	{true, false} false	WLCF/CMT	Aggregate cash flow based on product code.	No
agyCoeff	0.0	WLCF/CMT	Maximum haircut for cash equivalents as defined in FAS 95, Government securities, and securities of the reporting Enterprise. See Table 3-31 of the RBC Rule.	No
alpha	-0.002977	WLCF/CMT	HPI Dispersion Parameter. See Table 3-21 of the RBC Rule.	No
bbbCoeff	0.28	WLCF/CMT	Maximum haircut for non-derivative contract counterparties or instruments rated A. See Table 3-31 of the RBC Rule.	No
beta	-0.000024322	WLCF/CMT	HPI Dispersion Parameter. See Table 3-21 of the RBC Rule.	No
bmfCoeff	1.518	WLCF/CMT	Multifamily Default Equation Balloon Maturity Flag Coefficient. See Table 3-39 of RBC Rule.	No
ceCoeff	0.0	WLCF/CMT	Values defined in Table 3-31 of the RBC technical appendix.	No
ceInputFlag	{true, false} false	WLCF/CMT	true : produce CE input intermediate values and store them in the ce sub-directory under the	No

Key	Values {Value Set} Default	Module	Purpose	Required
			<p>directory specified by the rootDataDirectory parameter.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce ce input intermediate values.</p>	
ceOther	1.0	WLCF/CMT	<p>Values defined in Table 3-31 of the RBC technical appendix.</p>	No
ceOutputFlag	{true, false} false	WLCF/CMT	<p>true : produce ce output intermediate values and store them in the ce sub-directory under the directory specified by the rootDataDirectory parameter.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce ce output intermediate values.</p>	No
cmtCashflowFileName	{path/filename}	WLCF/CMT	<p>File stores result of CMT.</p> <p>Path must specify the full path to the target result set.</p>	Yes
cmtInputFlag	{true, false} false	WLCF/CMT	<p>true : produce CMT input intermediate values and store them in the cmt sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce CMT input intermediate values.</p>	No
cmtOutputFlag	{true, false} false	WLCF/CMT	<p>true : produce CMT output intermediate values and store them in the cmt sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce CMT output intermediate values.</p>	No
dcrCoeff	-2.368	WLCF/CMT	<p>Multifamily Default Equation Debt Service Coverage Ratio Coefficient. See Table 3-39 of RBC Rule.</p>	No
debug	{true, false} false	WLCF/CMT	<p>Turns on additional diagnostic output during the run.</p>	No
f	0.037	WLCF/CMT	<p>Foreclosure Costs as a decimal fraction of Defaulted UPB. See Table 3-42 of the RBC Rule.</p>	No
initialRentalRateCoeff	0.10	WLCF/CMT	<p>Initial rental vacancy rate. See Table 3-38 of the RBC Rule.</p>	No
ltvCoeff	0.8165	WLCF/CMT	<p>Multifamily Default Equation LTV Coefficient. See Table 3-39 of RBC Rule.</p>	No

Key	Values {Value Set} Default	Module	Purpose	Required
maInputFlag	{true, false} false	WLCF/CMT	<p>true : produce MA input intermediate values and store them in the ma sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce MA input intermediate values.</p>	No
maOutputFlag	{true, false} false	WLCF/CMT	<p>true : produce MA output intermediate values and store them in the ma sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce MA output intermediate values.</p>	No
mfdpInputFlag	{true, false} false	WLCF/CMT	<p>true : produce Multifamily Default/Prepay (MFD) input intermediate values and store them in the mfdp sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce MFD input intermediate values.</p>	No
mfdpInterceptCoeff	-4.553	WLCF/CMT	Multifamily Default Equation Intercept. See Table 3-39 of the RBC Rule.	No
mfdpOutputFlag	{true, false} false	WLCF/CMT	<p>true : produce MFD output intermediate values and store them in the mfdp sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce MFD output intermediate values.</p>	
mfglsInputFlag	{true, false} false	WLCF/CMT	<p>true : produce Multifamily Gross Loss Severity (MFGLS) input intermediate values and store them in the mfgls sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i></p> <p>false : don't produce MFGLS input intermediate values.</p>	No
mfglsOutputFlag	{true, false} false	WLCF/CMT	<p>true : produce MFGLS output intermediate values and store them in the mfgls sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: <i>This option will produce voluminous</i></p>	No

Key	Values {Value Set} Default	Module	Purpose	Required
			<p>outputs. Please ensure you have large amounts of disk space available.</p> <p>false : don't produce MFGLS output intermediate values.</p>	
mfMf	9.0	WLCF/CMT	Time from Default to completion of foreclosure (REO acquisition) for multifamily loans. See Table 3-44 of the RBC Rule.	No
mfMr	15.0	WLCF/CMT	Months from REO acquisition to REO disposition for multifamily loans. See Table 3-44 of the RBC Rule.	No
mqRetained	0.0	WLCF/CMT	Months Delinquent: time during which Enterprise pays delinquent loan interest to MBS holders (retained loans). See Table 3-22 of the RBC Rule.	No
mqSold	4.0	WLCF/CMT	Months Delinquent: time during which Enterprise pays delinquent loan interest to MBS holders (sold loans). See Table 3-22 of the RBC Rule.	No
newArmFlagCoeff	0.4193	WLCF/CMT	Multifamily Default Equation New ARM Flag Coefficient. See Table 3-39 of the RBC Rule.	No
newBalloonFlagCoeff	0.0	WLCF/CMT	Multifamily Default Equation New Balloon Flag Coefficient. See Table 3-39 of the RBC Rule.	No
newBookFlagCoeff	-1.219	WLCF/CMT	Multifamily Default Equation New Book Flag Coefficient. See Table 3-39 of the RBC Rule.	No
nls_idx_code	GS006	WLCF/CMT	Discount Rate used for Loss Severity Calculations. See Table 3-44 of the RBC Rule.	No
nlsInputFlag	{true, false} false	WLCF/CMT	<p>true : produce Net Loss Severity (NLS) input intermediate values and store them in the nls sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</p> <p>false : don't produce NLS input intermediate values.</p>	No
nlsOutputFlag	{true, false} false	WLCF/CMT	<p>true : produce NLS output intermediate values and store them in the nls sub-directory under the directory specified by the rootDataDirectory parameters.</p> <p>WARNING: This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</p> <p>false : don't produce NLS output intermediate values.</p>	No
numThreads	4	WLCF/CMT	specifies number of threads for Whole Loan Cashflow and Commitment.	Yes
operationExpenseCoeff	0.472	WLCF/CMT	Operating expenses as a share of gross potential rents. See Table 3-23 of the RBC Rule.	No
phaseIn	120.0	WLCF/CMT	See section 3.6.3.6.4 of the RBC Rule.	No
r	0.163	WLCF/CMT	REO Expenses as a decimal fraction of Defaulted UPB. See Table 3-42 of the RBC Rule.	No
rhcCoeff	0.07	WLCF/CMT	Net REO holding costs as a decimal fraction of Defaulted UPB. See Table 3-44 of the RBC Rule.	No

Key	Values {Value Set} Default	Module	Purpose	Required
rootDataDirectory	{path/directory} <i>ex: /data</i>	WLCF/CMT	Specifies the root data directory where all the intermediate values will be saved.	No
rp	0.63	WLCF/CMT	REO proceeds as a decimal fraction of defaulted UPB. See Table 3-44 of the RBC Rule.	No
rr	0.61	WLCF/CMT	Recovery Rate for Defaulted loans in the BLE, as a percent of predicted house price using HPI (decimal). See Table 3-42 of the RBC Rule.	No
rufCoeff	0.0	WLCF/CMT	Multifamily Default Equation Ratio Update Flag Coefficient. Obsolete.	No
sfdpExplVarOutputFlag	{true, false} false	WLCF/CMT	true : produce Single Family Default and Prepay (SFDP) ExplVar output intermediate values and store them in the sfdp sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce SFDP ExplVar output intermediate values.	No
sfdpInputFlag	{true, false} false	WLCF/CMT	true : produce SFDP input intermediate values and store them in the sfdp sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce SFDP input intermediate values.	No
sfdpLtvOutputFlag	{true, false} false	WLCF/CMT	true : produce SFDP LTV output intermediate values and store them in the sfdp sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce SFDP LTV output intermediate values.	No
sfdpOutputFlag	{true, false} false	WLCF/CMT	true : produce SFDP output intermediate values and store them in the sfdp sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce SFDP output intermediate values.	No
sfglsInputFlag	{true, false} false	WLCF/CMT	true : produce Single Family Gross Loss Severity (SFGLS) input intermediate values and store them in the sfgls sub-directory under the directory specified	No

Key	Values {Value Set} Default	Module	Purpose	Required
			by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce SFGLS input intermediate	
sfGlsOutputFlag	{true, false} false	WLCF/CMT	true : produce SFGLS output intermediate values and store them in the sfGls sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce SFGLS output intermediate values.	No
sfMf	13.0	WLCF/CMT	Months to Foreclosure: number of missed payments through completion of foreclosure for single-family loans. See Table 3-42 of the RBC Rule.	No
sfMr	7.0	WLCF/CMT	Months from REO acquisition to REO disposition for single-family loans. See Table 3-42 of the RBC Rule.	No
uwDcrCoeff	1.220	WLCF/CMT	Multifamily Default Equation Underwater Debt-Service Coverage Flag Coefficient. See Table 3-39 of RBC Rule.	No
wlcfCashflowFileName	{path/filename}	WLCF/CMT	File stores results of WLCF . This parameter is required. Path must specify the full path to the target result set.	Yes
wlcfHdrOutputFlag	{true, false} false	WLCF/CMT	true : produce WLCF header output intermediate values and store them in the wlcf sub-directory under the directory specified by the rootDataDirectory parameters. false : don't produce WLCF header output intermediate values.	No
wlcfInputFlag	{true, false} false	WLCF/CMT	true : produce WLCF input intermediate values and store them in the wlcf sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i> false : don't produce WLCF input intermediate values.	No
wlcfOutputFlag	{true, false} false	WLCF/CMT	true : produce WLCF output intermediate values and store them in the wlcf sub-directory under the directory specified by the rootDataDirectory parameters. WARNING: <i>This option will produce voluminous outputs. Please ensure you have large amounts of disk space available.</i>	No

Key	Values {Value Set} Default	Module	Purpose	Required
			false : don't produce WLCF output intermediate values.	

3.2 Application Run Execution

This section discusses the steps for running the model. The model is executed, or run, using the BASH script file, “rbc_execute.bash”. Alternatively, the individual modules can be run by directly executing the compiled module binaries. The instructions that follow describe running the model using the “rbc_execute.bash” script, however, a synopsis of executing the model binaries will also be provided at the end of this section. Running the model assumes that the application has been installed and configured as described in the *Risk-Based Capital Simulation Application Installation Manual*.

3.2.1 Environment Settings

Before the application is run, the UNIX environment variables must be updated. Reference Section 4.2.1 - Step 4, of the *Risk-Based Capital Simulation Application Installation Manual* for specific instructions.

Locate and change your working directory to the RBCSIM installation home directory. For example, if the directory is called **RBCSIM-B20051031-V1.0** in /usr/apps:

- **command:** `cd /usr/apps/RBCSIM-B20051031-V1.0/config`

Source the appropriate environment file.

- **command:** `source rbcenv.csh` (if using *cshell*)
- **command:** `. rbcenv.bash` (if using *bash*, *Korn*, or *Bourne shell*)

Note: the script sets the following environment variables:

RBC_HOME, FSM_HOME, PATH, and RBC_SRC_HOME.

3.2.2 Parameter Configuration Files

The model reads one or more configuration files when it is executed. These files contain runtime configuration parameters used by the model. See section 3.1.3 of this document for a description of the parameters and their allowable values. Before the application is run, create or modify the parameter configuration files.

3.2.3 The “rbc_execute.bash” Script

3.2.3.1 Synopsis

```
rbc_execute.bash [-r modules] [-c environment-config] [-u username] config-file [runset]
```

```
rbc_execute.bash -h
```

```
rbc_execute.bash -l
```

3.2.3.2 Description

The “rbc_execute.bash” file is a BASH script for running the model.

In the first synopsis form, the script will execute the model binaries using the parameter configuration file provided on the command-line and the “environment.config” file in the location specified by the \$FSM_HOME environment variable or in \$RBC_HOME/config directory if \$FSM_HOME is not defined. The user can specify a different path for the “environment.config” using the ‘-c’ flag. When

using this flag, the full pathname, to include “environment.config” must be specified. The configuration file, provided on the command-line, must provide the full path information for the file also.

The default list of modules is the following:

CMT	-	Commitments
WLCF	-	Whole Loans
MRB	-	Mortgage-Revenue Bonds
MBS	-	Single-Class Mortgage-Backed Securities
NMI	-	Non-Mortgage Instruments
RDM	-	Reporting and Decisions Module

The user can specify which modules to run using the ‘-r’ flag. The list of additional modules that can be run is the following:

REMIC-	Multi-Class Mortgage-Backed Securities	
AMT	-	Alternative Modeling Techniques
FUT	-	Futures

Note: data for the above three modules are not provided with the stylized data set. See the *Risk-Based Capital Stylized Data Set Overview* for a description of the stylized data set.

When providing a list of modules to run, they should be colon, ‘:’, delimited with no spaces. For example:

```
rbc-execute.bash -r WLCF:MRB:FUT:RDM ...
```

will only run the Whole Loan, Mortgage-Revenue Bonds, Futures and RDM modules. The user can also enter a value of “ALL” when specifying the module list. This option will run all the modules.

The script will run the stylized up-rate scenario if a Run-Set is not provided on the command line. Finally, the script assumes the user’s database login and UNIX login are the same. The ‘-u’ switch can be used to specify the database login name when the user’s database and UNIX login names are different.

The second synopsis form will print the script’s usage statement to the console.

The third synopsis form will print a list of available Run-Sets to the console.

3.2.3.3 Options

The script file supports the following options.

- | | |
|----|--|
| -r | allows the user to specify the list of modules to execute. Valid flag values are: ALL, which runs all modules; ACME, which runs the CMT, WLCF, MRB, MBS, NMI and RDM modules for the stylized data; or the user-provided list of modules. When specifying the list of modules to run, separate them using the pipe (‘ ’) character with no spaces. |
| -c | allows the user to specify the “environment.config” file to be used for the run. The full path must be provided to include the filename, which must be “environment.config”. |

- u allows the user to specify the database login name to use for the run.
- l prints a listing of available Run-Sets that can be executed.
- h prints a usage statement.

3.2.4 Executing the Model Binaries

The list of application/model binaries is the following:

wlcf	Whole Loan CashFlow, which is used to run the whole loan (WLCF) and the commitments (CMT) modules.
rbc_mrs	Mortgage-Related Securities, which is used to run the Single-Class Mortgage-Backed Securities (MBS), the Mortgage Revenue Bonds (MRB) and the Multi-Class Mortgage-Backed Securities (REMIC) modules.
rbc_nmi	Non-Mortgage Instruments, which is used to run the Alternative Modeling Treatment (AMT), the Non-Mortgage Instrument (NMI) and the Futures (FUT) modules.
rdm	Reporting and Decisions Module.

The method for running is the same for all the binaries. The command line is:

model_binary config_file database_username database_password module_name

Where:

<i>model_binary</i>	is one of wlcf, rbc_mrs, rbc_nmi or rdm
<i>config_file</i>	is the name of the config file containing the run-time configuration parameters
<i>database_username</i>	is the user's database login name
<i>database_password</i>	is the user's database login password
<i>module_name</i>	is one of WLCF, CMT, MBS, MRB, REMIC, AMT, NMI or FUT depending on which model binary is executed

4. OUTPUT RESULTS

4.1 Cash Flow Files

The Cash Flow file is an ASCII text file. Each line is divided into a series of space-delimited fields. Lines are grouped into instrument modeling detail records. Each instrument modeling detail record has two sections. There is a header section followed by detailed monthly data.

There are three different formats for cash flow files. The following are representative record layouts for the formats. For all formats, the item in the first column is the OFHEO Ledger Code.

Table 4-1: Whole Loan Cash Flow Example (Retained)

A1121	MAT	FORMAT	Opening_Bal	Sequence_Num	Deferred_Bal	Coupon	Fl_Dys_Sch	Fl_Dys_Prepay	Issue
A1121	121	R0WHL	9,999,999,999.99	WL000001	-999,999.99	0.0	0	0	0
A1121	Month	UPB	Sched_Prin	Prepay_Prin	Default_Prin	Losses	Interest	Amrt_Def_Bal	
	1	9,999,999,999.99	9,999,999.99	99,999,999.99	999,999.99	-999,999.99	99,999,999.99	9,999.99	
	2	9,999,999,999.99	9,999,999.99	99,999,999.99	999,999.99	-999,999.99	99,999,999.99	9,999.99	

Table 4-2: Whole Loan Cash Flow Example (Sold)

OBA111	MAT	FORMAT	Opening_Bal	Sequence_Num	Deferred_Bal	Coupon	Fl_Dys_Sch	Fl_Dys_Prepay	Issue	
OBA111	121	S0WHL	9,999,999.99	CMT00001	0.00	0.0	99	99	9	
OBA111	Month	UPB	Sched_Prin	Prepay_Prin	Default_Prin	Losses	Interest	Amrt_Def_Bal	Guar_Fee	Float
	1	9,999,999.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	9,999,999.99	99,999.99	9,999,999.99	9,999,999.99	99,999.99	99,999,999.99	0.00	999,999.99	999,999.99

Table 4-3: Whole Loan Cash Flow Description

Section	Column Name	Definition
Header	Maturity	Remaining Term
	FORMAT	“R0WHL” = Retained; “S0WHL” = Sold
	Opening_Bal	Current UPB amount as of Reporting Date
	Sequence_Num	“WL” or “CMT” + sequence number
	Deferred_Bal	Unamortized Premiums or Discounts
	Coupon	Coupon Rate
	Fl_Days_Sch	Float Days Scheduled Principal and Interest
	Fl_Dys_Prepay	Float Days Prepaid Principal
	Issue	Month Purchased
Entry	Month	Month 1 .. Remaining Maturity
	UPB	Group Unpaid Principal Balance (PUPB) of Performing Loans
	Sched_Prin	Scheduled Principal Received

Section	Column Name	Definition
	Prepay_Prin	Prepaid Principal Received
	Default_Prin	Defaulted principal
	Losses	Credit Losses
	Interest	Total Interest Received
	Amrt_Def_Bal	Monthly Amortization Expense Related to Deferred Balance
	Guar_Fee	Guarantee Fees Received
	Float	Float Income Received

Table 4-4: Mortgage Related Securities and Non-Mortgage Instruments Cash Flow Example

A11311	Maturity	FORMAT	Opening	Inst_id	PROD_TYPE	UNAM_FEE	ISS_MONTH	OPT_EXEC_MON	ISS_RATING	PAY_REC
A11311	999	N0MRB	9,999,999.99	MRB00001	NNTY12	0.00	99	99	XXX	rec
A11311	Month	UPB	PrincipalPay	Interest	Monthly_int	Unamort	Coupon	Hair_cut	Actions	
	1	9,999,999.99	99,999.99	99,999.99	99,999.99	0.00	0.99	99.99	-	
	2	9,999,999.99	99,999.99	99,999.99	99,999.99	0.00	0.99	999.99	-	

Table 4-5: Mortgage Related Securities and Non-Mortgage Instruments Cash Flow Description

Section	Column Name	Definition
Header	Maturity	Stated maturity of the instrument
	FORMAT	N0 + module name
	Opening	Opening balance or Current Face amount
	Inst_id	module name + sequence number
	PROD_TYPE	Product Type <ul style="list-style-type: none"> The first character is the Call Type which is either Y or N depending whether the instrument is callable or not. The second character is the Put Type which is either Y or N depending whether the instrument is putable or not. The third character is an indicator of fixed or floating coupon/interest rate whose value is either F (fixed) or T (floating). The fourth character is an indicator of whether the principal amortizes whose value is either Y or N. Characters five and six contain the number of times a year the instrument pays coupon/interest in a right justified zero filled format.
	UNAM_FEE	Unamortized premiums, discounts or fees
	ISS_MONTH	Issue month (-10)
	OPT_EXEC_MON	Option Execution Month (Call Month) (120)
	ISS_RATING	Security Rating
	PAY_REC	Indicates whether the security holder pays or receives interest
Entry	Month	Month 1 of Stress Test through Remaining Maturity
	UPB	Unpaid Principal Balance

Section	Column Name	Definition
	PrincipalPay	Total Principal Received/Paid
	Interest	Total Interest Received/Paid
	Monthly_int	Monthly Interest Accrual/Expense.
	Unamort	Amortization Expense
	Coupon	Coupon Rate
	Hair_cut	Total Haircut Amount
	Actions	<p>Actions available is a single field that provides a variable amount of pipe delimited information as follows:</p> <ul style="list-style-type: none"> • R - Could reprice whether or not it actually does • C - Could be called whether or not it actually does • P - Could be put whether or not it actually does • \$ - Interest payment is due • M - Matures • E - Option exercised • S - Principal could change according to contract • Y - Principal prepays whether or not it actually does • L - Principal could prepay but is locked out

4.2 Projected Interest and Property Valuation Rates

Projected interest and property valuation rates are calculated at run-time by the RBCSIM software. The ability to store the projected rates into a database, or load the projected rates from a database, has been provided to support analysis.

Projected interest rates are stored in the “fsm_proj_idx” table, which has the following structure:

Column Name	Sybase Data Type	Length
profile_name	varchar	50
idx_code	varchar	8
month	int	4
rate	float	8

Projected house price growth rates are stored in the “fsm_adj_hpi” table, which has the following structure:

Column Name	Sybase Data Type	Length
profile_name	varchar	50
quarter	tinyint	1
rate	float	8

Projected rent growth rates are stored in the “fsm_adj_rpi” table, which has the following structure:

Column Name	Sybase Data Type	Length
profile_name	varchar	50

month	tinyint	1
rate	float	8

Each set of projected rates stored in these tables is identified with a unique “profile_name” that is created in the “fsm_run_profile” table.

4.3 RDM Reports

The RBCSIM’s Reporting and Decision Module produces a Capital Adequacy report and a set of supporting financial statements. The statements consist of 121 monthly and 11 annual balance sheets, 120 monthly and 10 annual income statements, 120 monthly and 10 annual cash flow statements, and the capital requirement.

The information for the reports and statements are stored in the database by the RDM. The SQR Report utility generates the reports and financial statements from the stored database information and writes them to the file system as text files suffixed with “.LIS”. (Note: Postscript is also an option).

The following reports are produced:

Balance Sheet

Balance Sheet

Schedule A.1 - Mortgages, Net

Schedule A.2 - Mortgages, Net

Schedule B – Investments

Schedule C - Other Assets

Schedule F.1 - Mortgage Portfolio Sold

Schedule F.2 - Mortgage Portfolio Sold

Schedule E - Other Liabilities

Schedule D - Total debt securities, net

Schedule D.1 - Existing debt securities, net

Schedule D.2 - New debt securities, net

Schedule O – Derivatives

Income Statements

Income Statements

Schedule M - Income Taxes

Schedule L - Administrative Expenses

Schedule K - Allowance for Losses

Schedule J - Net Guarantee Fee Income from Sold Mortgage Portfolio

Schedule J.2 - Net Amortization Income from Sold Mortgage Portfolio

Schedule J.1 - Guarantee Fee Income from Sold Mortgage Portfolio

Schedule I - Interest on Debt Securities

Schedule H - Income on Investments

Schedule G - Net Interest Income from Retained Mortgage Portfolio

Schedule G.2 - Net Amortization Income from Retained Mortgage Portfolio

Schedule G.1 - Interest Income from Retained Mortgage Portfolio

Statement of Cash Flow

Statement of Cash Flow

Miscellaneous

Capital Adequacy Report

Analytics Report

4.4 Logs

The RDM generates a comma delimited log file representing the starting position and cashflow values booked during the run.

Table 4-6: Log File Example

<u>Line Number</u>	<u>Month</u>	<u>OFHEO Ledger Code</u>	<u>Reference Field</u>	<u>Accounting Entry</u>	<u>Transaction Amount</u>
1028303	111	E1312	L113.00000014XX	D	71331.52
1028304	111	L2112	L113.00000014XX	C	71331.52
1028305	111	L2112	L113.00000014XX	D	937500
1028306	111	A3104	L113.00000014XX	C	937500
1028307	111	L113.C.0.7	L113.00000014XX	D	25000000

Sample Log File Text:
1,0,A2,SP,B,-24681246.80
2,0,A2,SP,B, 24681246.80
1028303,111,A3101,A1122.WL000051,D,123456.85
1028303,111,A41,A1122.WL000051,C,123456.85
1028303,111,E1312,L113.00000014XX,D,71331.52
1028304,111,L2112,L113.00000014XX,C,71331.52
1028305,111,L2112,L113.00000014XX,D,937500.00
1028306,111,A3104,L113.00000014XX,C,937500.00
2028303,0,L2113,MonthOne,D,0.00
2028304,111,A3109,ADMIN_EXP,D,31111111.00

Table 4-7: Log Entry Definitions

Log Entry	Log Entry Definition
Line Number	Transactions are posted in sequence as data is read in from the database and the cash flow file, and then as the decision loop is executed.
Month	Month during the simulation the transaction is posted.
OFHEO Ledger Code	General Ledger account the transaction is posted to.
Reference Field	Indicates the instrument associated with the accounting entry. Entries posted from the cash flow file are processed and are comprised of the OFHEO Ledger Code with the CUSIP, if applicable, and module (WL = Whole Loans; CMT = Commitments; MRB = Mortgage Revenue Bonds; MBS = Mortgage-Backed Securities; REMIC = Multi-Class MBS) appended. Entries posted as the decision loop are executed and are comprised of a word indicating the decision element (ADMIN_EXP = Administrative Expense; EOP = End of Period; LIQ_INV = Liquidity; MonthOne = Unique month one entries; NSTD = Short Term Debt; NLTD = Long Term Debt; PFML = Provision for Mortgage Loss; TAX = Taxes).
Accounting Entry	D = Debit; C = Credit; B = Booking of starting balance
Transaction Amount	Dollar amount of the posted transaction.

APPENDIX A: ERROR MESSAGES

Error Code	Error Level	Message	Description
Common			
100	WARNING	"Program Warning"	Generic program warning. This message is accompanied by a more detailed message.
101	ERROR	"Program Error"	Generic program error. This message is accompanied by a more detailed message.
102	ERROR	"Error:Configuration File Error, exiting program"	Configuration file is missing or cannot be opened.
103	ERROR	"Error:Login to database failed"	Database login failed. Check database name, user ID, and password.
104	ERROR	"Error:Configuration Error, Number of threads is <= 0"	Parameter: numThreads entry is invalid.
105	ERROR	"Error:Invalid Domain"	Domain must be AMT, CMT, WLCF, MBS, MRB, NMI, REMIC, FUT, or RDM.
106	WARNING	"Warning:Cannot open file"	Non-fatal file open error.
107	ERROR	"Error:Invalid number of arguments"	Invalid number of command-line arguments.
108	WARNING	"Warning:Invalid parameter in configuration file, using default"	A parameter value in the configuration file is invalid. The default value is being used. Reference: Table 3-1: RBC-SIM Parameters.
109	ERROR	"Error:Required parameter missing or invalid "	A required parameter is missing from the configuration file.
110	ERROR	"Error:Cannot open file",	Fatal file open error
111	ERROR	"Error:Log directory is invalid"	The log directory is not valid. Verify that the directory exists.
Whole Loan			
200	WARNING	"Warning: Number of cmt lg = 0"	Number of loan groups equals 0.
201	ERROR	"Error:Invalid Interest Rate Scenario"	Invalid interest rate scenario.
202	WARNING	"Warning:Invalid PrdCode for	Invalid product code for loan

Error Code	Error Level	Message	Description
		loan_group_nbr"	group.
203	ERROR	"Error:Can not get Interest Rate Map for IdxCODE"	Cannot retrieve interest rate map for index code.
204	WARNING	"Warning:Cannot get CMT wl"	Cannot retrieve CMT whole loan index.
205	WARNING	"Warning:Cannot get CMT sf"	Cannot retrieve CMT single family index.
206	WARNING	"Warning:Unknown IO"	Unknown input-output type.
207	WARNING	"Warning:Invalid IO Type"	Invalid input-output type.
208	WARNING	"Warning:Unknown Explanatory Variable"	Unknown explanatory variable.
209	WARNING	"Warning:Invalid lookUpAgeVariables"	lookUpAgeVariables out of range.
210	WARNING	"Warning:Invalid lookUpLtvVariables"	lookUpLtvVariables out of range.
211	WARNING	"Warning:Invalid lookUpPneqVariables"	lookUpPneqVariables out of range.
212	WARNING	"Warning:Invalid lookUpRIsVariables"	lookUpRIsVariables out of range.
213	WARNING	"Warning:Invalid lookUpRsVariables"	lookUpRsVariables out of range.
214	WARNING	"Warning:Invalid lookUpPsVariables"	lookUpPsVariables out of range.
215	WARNING	"Warning:Invalid lookUpYcsVariables"	lookUpYcsVariables out of range.
216	WARNING	"Warning:Invalid lookUpBcalVariables"	lookUpBcalVariables out of range.
217	WARNING	"Warning:Cannot get Ltv for Quarter"	Cannot retrieve LTV for quarter.
218	ERROR	"Error:Cannot get WL Master Data"	Cannot retrieve whole loan master data for loan group.
219	ERROR	"Error:Cannot get SF Data Elements"	No single family data elements.
220	ERROR	"Error:Invalid Business Type"	Invalid business type for loan group.
221	ERROR	"Error:Cannot get Arm Data"	No ARM data for loan group.
222	ERROR	"Error:Cannot proceed because there is no CMT WL/SF data"	No CMT whole loan, single family data.
223	ERROR	"Error:Cannot get ProjIdx map"	Cannot retrieve project index map.
224	ERROR	"Error:Invalid Loading Option"	The loading option for the loan group must be either CMT or WLCF.
225	ERROR	"Error:Invalid Run Mode"	The run mode must be either CMT or WLCF.

Error Code	Error Level	Message	Description
226	ERROR	"Error:There is no whole loan record to load"	No whole loan record to load.
227	ERROR	"Error:Cannot get IDX MAP"	Cannot retrieve index map.
228	ERROR	"Error:Cannot get FF1W Data"	Data retrieval error.
IRPV			
300	WARNING	"Warning:Cannot find Rate for IdxCODE"	Cannot find interest rate for index code.
301	ERROR	"Error:Cannot create interest rate output file"	Cannot create interest rate output file. Check directory permissions.
302	WARNING	"Warning:Cannot find associate idx_code"	Associate index code not in database.
303	WARNING	"Warning:Cannot set nontreasury spread"	Appropriate historical index data not in database, cannot set non-treasury spread.
304	WARNING	"Warning:Cannot set Mrtg spread"	Appropriate historical index data not in database, cannot set mortgage spread.
305	ERROR	"Error:Please check values for IRPV keys"	Invalid Key-Value pair for IRPV parameter.
MRS			
400	ERROR	"Error:No AOLTV records found!"	AOLTV records not found.
401	ERROR	"Error:Invalid icmodbPtr"	Intex subroutine error.
402	WARNING	"Warning:Unable to set up cusip tables"	Cusip table error.
403	ERROR	"Error:Invalid notional flag!"	Invalid notional flag.
404	ERROR	"Error:Intex icmo_setup_icmomiscp procedure returned a NULL"	Intex subroutine error.
405	WARNING	"Warning:Intex data error"	Intex data error, check Intex files.
NMI			
500	ERROR	"Error:Bad input stream for Instrument IDList"	Unable to read instrument ID list.
501	WARNING	"Warning:int_paymt_formula will not run"	Interest payment formula is unable to execute.
502	ERROR	"Error:Cannot find the rating in the non derivative haircut table"	Rating in the non-derivative haircut table is not found.
503	WARNING	"Warning:Newton-Raphson failed"	The Newton-Raphson calculation failed.

Error Code	Error Level	Message	Description
504	WARNING	"Warning:Instrument ID not found."	Instrument ID no found.
505	WARNING	"Warning:Performance History does not exist"	Performance history data is not in database.
506	WARNING	"Warning:STEP Idx_formula does not exist"	STEP index formula does not exist.
507	WARNING	"Warning:FLOAT Idx_formula does not exist"	Float index formula does not exist.
508	WARNING	"Warning:no associate table"	Associate table not found.
509	WARNING	"Warning:Swaption setup failure"	Swaption setup failed.
510	WARNING	"Warning:Could not determine Basis Swaption short leg for instmt_id"	Could not determine basis swaption for specified instrument id.
511	WARNING	"Warning:No associations found for instrument id"	Association not found for instrument ID.
512	WARNING	"Warning:The swaption does not have 2 Swap legs"	Swaption does not have swap legs.
513	WARNING	"Warning:Unable to load Swaption's long swap leg for instrument id"	Unable to load swaption's long swap leg for instrument ID.
514	WARNING	"Warning:Swaption load instrument failure"	Swaption load instrument failed.
515	WARNING	"Warning:No Margin Over Index (spread) for Swaption's Swap leg with instrument id"	No Margin Over Index (spread) for swaption's Swap leg with instrument id"
516	WARNING	"Warning:Unable to calculate option frequency for instmt_id"	Unable to calculate option frequency for instrument ID.
517	WARNING	"Warning:Bad data for instmt_id"	Bad data for instrument ID.
518	WARNING	"Warning:Invalid Exercise Convention Type for Swaption with instmt_id"	Invalid exercise convention type for swaption with instrument ID.
519	ERROR	"Error:Int_paymt_formula does not exist, aborting..."	Interest payment formula does not exist.
520	WARNING	"Warning:Unable to retrieve rates for instrument ID"	Unable to retrieve rates for instrument ID.
521	WARNING	"Warning:Option rates not found for instrument ID"	Option rates not found for instrument ID.
522	WARNING	"Warning:Invalid instrument type code"	Invalid instrument type code.
523	WARNING	"Warning:Invalid Rating Type code"	Invalid rate type code.

Error Code	Error Level	Message	Description
524	WARNING	"Warning:Invalid Credit Agency code"	Invalid credit agency code.
525	WARNING	"Warning:Invalid Transaction code"	Invalid transaction code.
526	WARNING	"Warning:Invalid Call Type code"	Invalid call type code.
527	WARNING	"Warning:Invalid Asset Type code"	Invalid asset type code.
528	ERROR	"Error:Invalid Amort Method code"	Invalid amortization method code.
529	ERROR	"Error:Invalid Position Type code"	Invalid position type code.
530	WARNING	"Warning:Invalid Day Count code"	Invalid day count code.
531	WARNING	"Warning:Invalid Option Type code",	Invalid option type code.
532	WARNING	"Warning:Invalid month"	Invalid month.
533	WARNING	"Warning:Interest Rate Map Not Found"	Interest rate map not found.
534	WARNING	"Warning:Cannot find instrument type"	Instrument type not found.
535	ERROR	"Error:Unkown instrument type"	Unknown instrument type.
536	ERROR	"Error:Index code out of range"	Index code out of range.
537	ERROR	"Error:Intex deal cannot be found"	Intex deal not found.
RDM			
600	ERROR	"Error:Run profile configuration error"	Fatal run profile configuration error. Check configuration file.
601	ERROR	"Error:Non-unique new run profile name"	The run profile name exists in the database. Either modify the run profile name for the RDM run (newRunProfileName), or set the overwrite flag to true (use runProfileName and overwrite = true).
602	ERROR	"Error:Invalid run profile"	The specified runProfileName does not exist in the database.
603	ERROR	"Error:Cannot save new run profile"	The new run profile cannot be saved to the database. Verify the user has the appropriate write permissions in the database.
604	ERROR	"Error:Financial statements exist for this run profile. Set overwrite to true to regenerate."	The run profile exists, however the "overWrite" flag is set to false. Set overwrite to true.
605	ERROR	"Error:SQR Source Directory value is invalid"	SQR source directory does not exist. Modify directory path in configuration file

Error Code	Error Level	Message	Description
			(sqrSourceDirectory).
606	ERROR	"Error:SQR Output Directory value is invalid"	SQR output directory does not exist. Modify directory path in configuration file (sqrOutputDirectory).
607	WARNING	"Warning:Report output not requested in configuration."	The SQR output directory is not specified in the configuration file.
608	ERROR	"Error:Request for index is out of bounds"	Fatal run-time error. Check cashflow files.
609	ERROR	"Error:Report error occurred."	Fatal run-time error. Check cashflow files.
610	WARNING	"Warning:Annual report is not available."	Annual report is not available.
611	WARNING	"Warning:Report is not available is ascii format!"	Report is not available in ASCII format.
612	WARNING	"Warning:Unable to Initialize Report Profile data from BD"	Unable to initialize report profile data.
613	ERROR	"Error:Save the Report Profile parameters failed."	Saving the report profile parameters, failed.
614	WARNING	"Warning:No Record Found"	Record not found.
615	ERROR	"Error:ReportProfile::load() failed."	Report profile load, failed.
616	ERROR	"Error:Abort Database transaction."	Database transaction aborted.
617	ERROR	"Error:Problem inserting rdm run into run_profile table, terminating..."	Insertion of RDM run into run profile table, failed.
618	ERROR	"Error:Run Profile save failed."	Run profilesave failed.
619	ERROR	"Error:Run Profile::load() failed."	Run profile load, failed.
620	ERROR	"Error:RunProfile::getProfileNames() failed."	Retrieving run profile names, failed.
621	ERROR	"Error:Interest Rate Not Found."	Interest rate not found.
622	ERROR	"Error:Invalid Refunding Method Found"	Invalid refunding method.
623	ERROR	"Error:Cash surplus is negative"	Cash surplus is negative.
624	WARNING	"Warning:Principal Problem for cusip"	Principal problem for CUSIP.
625	WARNING	"Warning:Discount Problem for cusip"	Discount problem for CUSIP.
626	ERROR	"Error:Invalid Account number"	Invalid account number.
627	ERROR	"Error:Problem With cashflow file"	Problem with cashflow file.
628	ERROR	"Error:NaN(s) found in cashflow file"	NaN(s) found in cashflow file.

Error Code	Error Level	Message	Description
629	ERROR	"Error:Need code for forward settlements in Mortgage Securities"	Code required for forward settlements in mortgage securities.
630	ERROR	"Error:Need code for forward settlements in SubordinatedDebt"	Code required for forward settlements in subordinated debt..
631	ERROR	"Error:Month Index out of range"	Month index is out of range.
632	ERROR	"Error:Quarter Index out of range"	Quarter index is out of range.
633	ERROR	"Error:Year Index out of range"	Year index is out of range.
634	ERROR	"Error:Problem inserting rdm run into financial_statement table, terminating..."	Error inserting RDM run into financial statement table.
635	ERROR	"Error:Invalid Mortgage Product Type"	Invalid mortgage product type.
636	ERROR	"Error:Invalid Multifamily Type"	Invalid multifamily type.
637	ERROR	"Error:Null Reference"	Internal null pointer error.
638	ERROR	"Error:Report Error"	Report generation error.
639	ERROR	"Error:No starting Position data for reporting date"	No starting position data for reporting date.
G640	ERROR	"Error:Accounting Flag is missing for account"	Accounting flag is missing for account.
641	ERROR	"Error:Accounting Flag has invalid value for account"	Invalid value for accounting flag.
642	ERROR	"Error:Error reading starting positions, aborting run"	Error reading starting positions.

APPENDIX B: SAMPLE CONFIGURATION FILE

```
[COMMON]
enterpriseName=FHLM
scenario=UP
rptQuarter=04
rptYear=2001
debug=false
intermediateValue=false
version=2008_04_30
description = "Test Run"
fpeLimit=1000000
catchFatalSignals=true
altLogFile=/tmp/rbcErrs.txt
;This is a comment
LogLevel=1
LogAppendFlag=false
databaseServer=dbserver
databaseName=dbname
NMIDatabaseName=dbname
intexDataCDU=/intex/cdu
intexDataCDI=/intex/cdi
logDirectory=${RBC_HOME}/rbc_run/test_results/Logs/

[IRPV]
intrRateInterpolate=true
intexDataSupplied=false
calcIR=
calcPV=true
saveIR2Db=false
savePV2Db=false
profileName=myProfile

[MRS]
mrbCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/mrb__.CF
mbsCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/mbs__.CF
remicCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/rem__.CF
useInstmtIds=true
instmtIdList=
intexDataSupplied=
intexDataFile=frejdeals.inf
aggregateByCusip=false
intermediateValue=false

[NMI]
useInstmtIds=true
instmtIdList=
nmiCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/nmi__.CF
```

```
amtCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/amt__.CF
futureCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/fut__.CF
NMIDatabaseName=dbname
```

[WLCF]

```
numThreads=4
rootDataDirectory=${RBC_HOME}/rbc_run/test_results/Cashflows
useInstmtIds=true
instmtIdList=('10001111','10001112','10001113','10001114')
aggregateByLedgerCode=true
aggregateByPrdCode=false
aggregateByLoanGrp=false
aggregateByLtvRange=false
wlcfcashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/wlf__.CF
cmtCashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/cmt__.CF
cmtInputFlag=false
cmtOutputFlag=false
maInputFlag=false
maOutputFlag=false
sfdpInputFlag=false
sfdpOutputFlag=false
sfdpLtvOutputFlag=false
sfdpExplVarOutputFlag=false
mfdpInputFlag=false
mfdpOutputFlag=false
sfglsInputFlag=false
sfglsOutputFlag=false
mfglsInputFlag=false
mfglsOutputFlag=false
ceInputFlag=false
ceOutputFlag=false
nlsInputFlag=false
nlsOutputFlag=false
wlcfcInputFlag=false
wlcfcOutputFlag=false
wlcfcHdrOutputFlag=false
```

[RDM]

```
cashflowFileName=${RBC_HOME}/rbc_run/test_results/Cashflows/all__.CF
sqrSourceDirectory=${RBC_HOME}/bin/SQR_reports/
sqrOutputDirectory=${RBC_HOME}/rbc_run/test_results/Logs/
batch=true
overWrite=
newRunProfileName=myProfile
#runProfileName=myProfile
endMonth=120
adminExpenseMethod=2
effectiveTaxRate=30.0
ReportProfilePeriod=B
ReportProfileLowerBound2=8
```

ReportProfileLowerBound3=9
ReportProfileLowerBound4=10
ReportProfileLowerBound5=11
ReportProfileLowerBound6=12