



# The IMSL<sup>®</sup> C Numerical Library

Getting Started Guide – A Technical Guide by  
Rogue Wave Software



[www.roguewave.com](http://www.roguewave.com)



# The IMSL<sup>®</sup> C Numerical Library Getting Started Guide

by Rogue Wave Software

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# Installing IMSL C Numerical Library

## 1. Executing the install program

Confirm you have the appropriate tar file for the hardware platform and operating system. The <tarfile> in the commands below display the name `cnl-2016.0.0sus121gc485x64.tar`. Execute the following commands from the directory that contains the downloaded archive:

```
tar xzf <tarfile>
imsl/install/imsl_install
```

## 2. License Agreement

This screen presents the end user license agreement. Press the <space bar> to scroll through to read the contents.

```
ROGUE WAVE (R) SOFTWARE LICENSE AGREEMENT
IMSL (R) C NUMERICAL LIBRARY, IMSL (R) C# NUMERICAL LIBRARY,
JMSL (TM) NUMERICAL LIBRARY AND IMSL (R) FORTRAN NUMERICAL LIBRARY
(MARCH 2015)

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OR
INSTALL THE SOFTWARE, AND SHOULD, WITHIN THIRTY (30) DAYS OF PURCHASE, RETURN
--More-- (3%)
```

When you reach the end of the license agreement, enter "y" and then <Enter> to continue the installation.

```
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re,
Inc. in the United States and other countries.

Do you agree to the terms of this license agreement (Y/N)?
█
```

## 4. Installation Information

This dialog introduces the install procedure. Press <Enter> to continue.

```
IMSL Installation

This procedure installs Rogue Wave Software's IMSL products.

During the installation session, you will be prompted for
various input. Choices that have default responses are
enclosed in brackets ([]).

To abort the installation procedure at any time, press ^C (Control-C).

Press <ENTER> or <RETURN> to continue: []
```

## 5. Install Directory

Set the installation directory. The default is the directory in which the installation script is executed. You are prompted for confirmation. Press <Enter>.

```
IMSL Installation

Enter the directory where you want to install the
IMSL products.

[/export/home5/homedir/hoose/CNL-2016.0]:
[]
```

At the next dialog, confirm your selection by pressing "y" and <enter> again.

```
IMSL Installation

Enter the directory where you want to install the
IMSL products.

[/export/home5/homedir/hoose/CNL-2016.0]:

The directory where you want to install is

/export/home5/homedir/hoose/CNL-2016.0.

Is this correct ([Y]/N)? 
```

## 6. Introduction to the CNL Modules

This dialog introduces the modules that are available for installation as part of the IMSL C Numerical Library. Press <Enter> to continue to the selection screen.

```
IMSL Installation

The Options Menu that follows this message contains options that
allow you to select modules for the supported environment.

Choosing a 'Select...modules' option from the Options Menu gives you
a list of modules and allows you to toggle them between selected and
not selected.

This installation procedure selects certain modules by default. To
view the default modules, choose the 'Show selected modules' option
from the Options Menu prior to selecting or deselecting any modules.

Press <ENTER> or <RETURN> to continue: 
```

## 7. MKL Information

You may optionally install an MKL performance version of the IMSL C Numerical Library. This dialog is simply informational and does not configure the installer to install the module.

Press <Enter> to continue.

```
IMSL Installation

This installation gives the installer the option of installing an
additional version of IMSL C Numerical Library which leverages the
Intel(R) Math Kernel Library (MKL) to enhance performance in functions
that use BLAS, FFTs, or LAPACK routines. Note that MKL is not covered
by the IMSL License Agreement. Go to www.intel.com to obtain more
information on Intel's MKL License Agreement.

By selecting the MKL-enabled version of the IMSL Library,
both the standard IMSL and MKL-enabled versions will be installed
and the LINK_CNL environment variable will link with the
MKL-enabled versions of the libraries.

By choosing not to select the MKL-enabled versions, only the
standard IMSL version of the libraries will be installed and the
LINK_CNL environment variable will link with the standard IMSL
versions of the libraries. No link environment variables will
be created for the MKL-enabled versions of the libraries. Refer
to the README files referenced at the conclusion of the installation
for more information.

By default the MKL-enabled version of the libraries are not selected.

Press <ENTER> or <RETURN> to continue: 
```



## 8. CUDA Information

You may optionally install a CUDA performance version of the IMSL C Numerical Library. This dialog is simply informational and does not configure the installer to install the module.

Press <Enter> to continue.

```
IMSL Installation

This installation gives the installer the option of installing an
additional version of IMSL C Numerical Library which leverages
the NVIDIA CUDA(TM) architecture to enhance performance in functions
that use BLAS routines. Note that the NVIDIA CUDA architecture
software supplied with this installation is not covered by the IMSL
License Agreement. Go to www.nvidia.com to obtain more information
on NVIDIA's CUDA License Agreement.

By selecting the CUDA-enabled version of the IMSL Library,
a CUDA-enabled version of the IMSL Library will be installed
in addition to the other IMSL Library options.

Refer to the README files referenced at the conclusion of the
installation for more information.

By default the CUDA-enabled version of the libraries are not selected.

Press <ENTER> or <RETURN> to continue: 
```

## 9. Module Selection

Review the list of available modules for Linux and type the corresponding numbers to toggle the selection. Select `x` to exit this menu and continue with installation.

```
IMSL Installation

MOD          SIZE
NUM Selection (KB)  DESCRIPTION
-----
1  MANDATORY  51512  C Numerical Library (Standard), Linux (x64), gcc 4.8.5
2  NOT SELECTED 290064 C Numerical Library (MKL-enabled), Linux (x64), gcc 4.8.5
3  NOT SELECTED 184040 C Numerical Library (CUDA-enabled), Linux (x64), gcc 4.8.5
4  SELECTED    84652  C Numerical Library Online Documentation
x  Exit Options Menu -- continue with installation

Space Required For Selected Modules: 136164 KB

To toggle modules between SELECTED and NOT SELECTED, enter the
number of the module (i.e. 2 or 3) and press RETURN.

Enter option: █
```

## 10. Hard Disk Space Confirmation

The required disk space is computed and compared to the amount of disk space available. To continue, enter `c` and press `<Enter>`. Press `q` to quit the install program or `m` to modify the selected modules.

```
IMSL Installation

The installation that you have selected requires 136164 KB of disk space.

It appears that you have 30432256 KB of disk space. This is sufficient
space to allow the installation to complete successfully.

Enter C to continue with the installation, Q to quit the installation,
or M to modify the selected modules: █
```

## 11. License Number

If you have a License Number, enter it. If you do not yet have a license number, or are evaluating the product, use the default 999999. Press <Enter> and then "y" to continue to the installation.

```
IMSL Installation

Enter your Rogue Wave Software license number.

If you are an evaluation site, the license number is 999999.

License Number [999999]: 
```

## 12. Installation Complete

When the install program is finished decompressing and copying files, you are presented with summary notes and returned to the command prompt.

```
IMSL Installation

The IMSL files have been loaded to disk.

The installation program has successfully completed.

Complete the installation by following the instructions
located in the file README located in the directory
/export/home5/homedir/hoose/CNL-2016.0/imsl/<product>/<arch>/notes.

Here <arch> is the environment mnemonic for the installed product(s)
and <product> is either fnl-xxx and/or cnl-xxx depending
on whether you installed IMSL Fortran Numerical Library or
IMSL C Numerical Library respectively. Here xxx represents the version
number of the product.

Before using any IMSL product the user will be required to reference
the README files documented above. These files contain important
information on the installation and use of the products.

Users familiar with our products may want to refer to the instructions
in the file QuickStart for abbreviated, less detailed, instructions.

[hoose@cnl900cen715gc485x64 ~/CNL-2016.0]$ 
```

## License Key Setup

This step is necessary only if you have an evaluation copy of IMSL C Numerical Library.


Using a text editor, create the license file `<install_dir>/license/ims1_eval.dat`, where `<install_dir>` is the IMSL C Numerical Library installation directory. Then, cut and paste the contents of the file you received via e-mail from the Rogue Wave License Administrator.

**Note:** To customize the license file name, set the environment variable `IMSL_LIC_FILE` to point to the license file name and the location of your choice (`<path>/<name>`).

## Using the IMSL C Numerical Library

### 1. Documentation

Documentation is supplied in both PDF and HTML formats, available from the main documentation page at `<install_dir>/ims1/cnl-2016.0.0/help`. Open the file `ims1.html` using your web browser.



Accelerating Great Code

Product Documentation	Additional Documentation
IMSL® C Math Library User Guide: <a href="#">HTML</a> <a href="#">PDF</a>	IMSL® C Numerical Libraries Getting Started Guide: Available on the Rogue Wave web site's <a href="#">CNL documentation page</a>
IMSL® C Stat Library User Guide: <a href="#">HTML</a> <a href="#">PDF</a>	DONLP2 User Guide <a href="#">PDF</a>

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## 2. Creating a program

This simple example program solves the following system of linear equations:

$$\begin{aligned}33x + 16y + 72z &= 129 \\ -24x - 10y - 57z &= -96 \\ 18x - 11y + 7z &= 8.5\end{aligned}$$

Copy the following text into an editor and save the file as `cn1.c`.

```
/* Program start */
/* The header file for Mathematics of the IMSL C Numerical Library. */
/* For Statistics, use <imsls.h>. */
#include <imsl.h>

main()
{
    /* variable declaration */
    int n = 3;
    float *x;
    static float a [ ] = {33.0, 16.0, 72.0,
                          -24.0, -10.0, -57.0,
                          18.0, -11.0, 7.0};

    static float b [ ] = {129.0, -96.0, 8.5};
    float *p_inva;

    /* The main IMSL function call to solve for x in Ax=B.

    * This is the floating point version, to use
    * double-precision arguments, call
    * imsl_d_lin_sol_gen */
    x = imsl_f_lin_sol_gen(n, a, b, 0);

    /* Optional arguments are included after required

    * arguments. These are usually preceded by a constant
    * named IMSL_* indicating which optional argument is
    * being passed. In this example, we request the
    * inverse of the a matrix */
```

```

x = imsl_f_lin_sol_gen(n, a, b, IMSL_INVERSE, &p_inva, 0);

/* Print the solution x and the inverse of a using
 * write_matrix, a printing utility */
imsl_f_write_matrix("Solution x", 1, n, x, 0);
imsl_f_write_matrix("Inverse of A", n, n, p_inva, 0);
}

/* Program end */

```

### 3. Compiling and running the program

The following steps detail how to compile and execute a program that uses the IMSL C Numerical Library for UNIX/Linux.

#### Setting the Environment Variables

Configure a setup shell script with the necessary environment variables required for compilation. Which shell script to use depends on the shell:

#### For the IMSL C Numerical Library Version 8.6 on Linux

##### C Shell

```
source <install_dir>/imsl/cnl-2016.0.0/<env>/bin/cnlsetup.csh
```

##### bash, bourne, K Shell

```
. <install_dir>/imsl/cnl-2016.0.0/<env>/bin/cnlsetup.sh
```

#### Compile the program

##### Shared Library

```
$CC $CFLAGS cnl.c -o cnl $LINK_CNL_SHARED
```

##### Static Library

```
$CC $CFLAGS cnl.c -o cnl $LINK_CNL_STATIC
```

## Execute the program

```
./cn1
```

```
Solution x
```

```
          1          2          3  
1.0          1.5          1.0
```

```
Inverse of A
```

```
          1          2          3  
1      0.1464      0.1899      0.0403  
2      0.1802      0.2237     -0.0321  
3     -0.0933     -0.1367     -0.0113
```

For more information, refer to the readme files in  
<install\_dir>/ims1/cn1-2016.0.0/<env>/notes.