jPhase GUI manual

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1 Introduction

This document serves as a manual for some of the features of the jPhase graphical user interface.

2 Manual

To run the jPhase graphical interface the user needs to initialize a `MainFrame` object and set it visible (see Figure 1).

```
package example;

import jphase.GUI.*;

public class JPhaseStarter {
    public static void main(String[] args){
        MainFrame myGUI = new MainFrame();
        myGUI.setVisible(true);
    }
}
```

Figure 1: jPhase graphical interface starting code

After setting the `MainFrame` visible, a new frame will appear. The features are in the *Phase Var* menu (see Figure 2). All the features have an associated panel and we will present a description of each of them followed by an example.

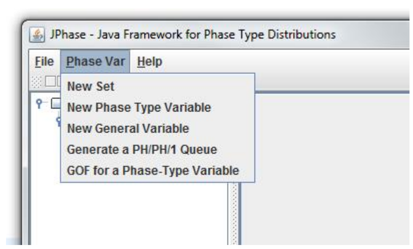

Figure 2: JPhase *Phase Var* menu

2.1 Random Variate Generator and Moment Calculator Panel

This feature can be found in the *Phase Var* menu, in the *New General Variable* option (see Figure 2). After selecting this option, the software generates a new panel which contains two tabs: one for the variate generation and moment calculator (see Figure 3) and one for the goodness-of-fit tests (see Figure 8). Each tab is explained below.

2.1.1 Random Variate Generator and Moment Calculator Tab

Description As described in the Appendix B, Version 2.5 of the SSJ library is implemented for the random variate generation and the goodness of fit test performer. In SSJ for generating random variates it is necessary to define a random uniform generator (from a list of possible generators), a distribution and a generator method for that distribution. In the developed interface the user can define (See Figure 3):

- The random uniform variates generator. In the first *change* button the user can change the generation method which uses a default one.
- The expected distribution and its parameters, which can be changed in the second *change* button.
- The generator method for the specific distribution. Only the normal distribution has more than one option and it is located in the third *change* button.
- A location folder for saving the data file that will serve as the input for jPhase. The browser for selecting the destination folder is located in the *select* button.

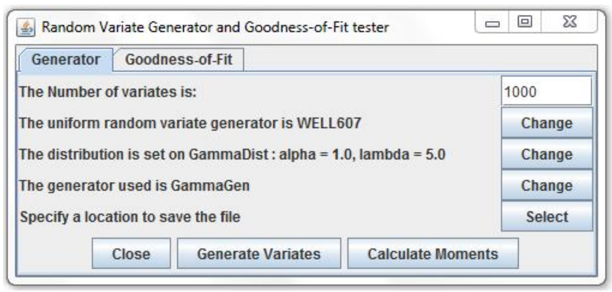

Figure 3: Variate Generator and Moment Calculator panel

The software can either generate the variates or calculate the moments of a distribution. In that case the user only needs to define a distribution and a location for the file that will contain the moments. As a result of the generation, the software shows a message with a summary of the process, which contains the number of variates generated, the distribution, and the location of the file (Figure 6). After that, the software automatically performs a goodness-of-fit test comparing the generated data file with the distribution (Figure 7).

Example In this section we will describe the process to generate 1000 Gamma variates with rate $\lambda = 5$ and $\alpha = 1$.

1) Select the *New General Variable* option in the jPhase graphical interface.

2) In this example we will change the uniform random generator method (the user can use the default one). First, click on the first *change* button (next to the uniform random variate generator label) and the menu shown in Figure 4 will appear. Choose *Well607* option (if the user wants more information about any algorithm she must click on the button next to the algorithm and a new window will be visible with the description) and then click on the *accept* button.

3) In order to change the distribution, click on the second *change* button (next to the distribution label) and the window shown in Figure 5 will appear. The user must select the *Gamma* option and click *accept*. In the *Parameter* windows write the $\lambda = 5$ and $\alpha = 1$ rates. Click on *accept*.

4) Click on the *Select* button and choose a location for the data file. In this case we choose $C : \backslash\backslash jMarkov\backslash$.

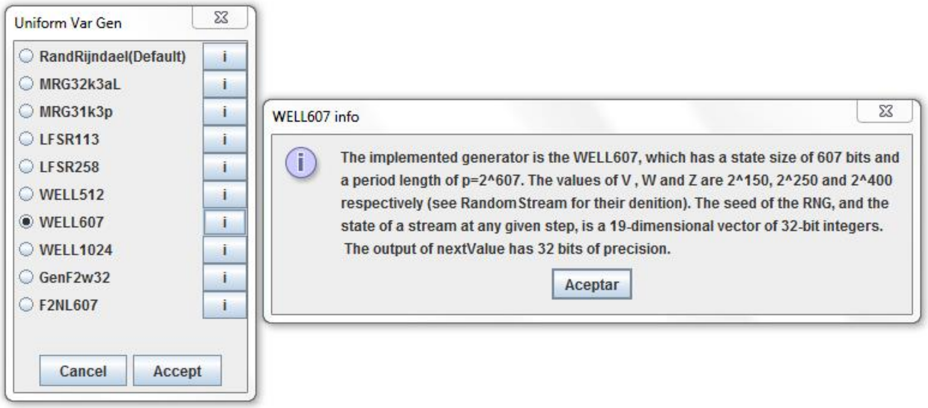

Figure 4: Uniform Random Variate Generator Panel

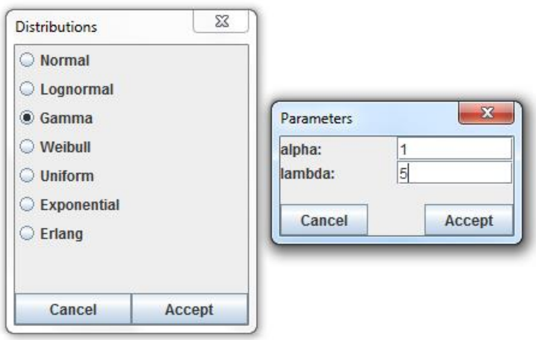

Figure 5: Distribution and Parameters Selection Panel

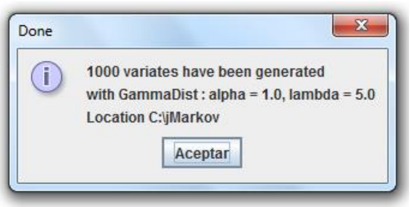

Figure 6: Generation Summary

5) Click on *Generate Variates* button. After this, the Figure 6 message should appear. Click *Ok*.

6) Finally the Figure 7 panel should appear. The user can save the histogram image or click on *Ok* to go back to the Generator tab.

The result of this procedure is a file in the selected location with 1000 variates. If instead of generating variates the user wants to calculate the moments she can skip step 2 and in step 5 click on *Calculate Moments*.

2.1.2 Goodness-of-Fit Test Tab

Description To perform a goodness-of-fit test the user has to define the number of groups for the Chi-Square test, the theoretical distribution, and a locations for the data file (See Figure 6). In Appendix A the

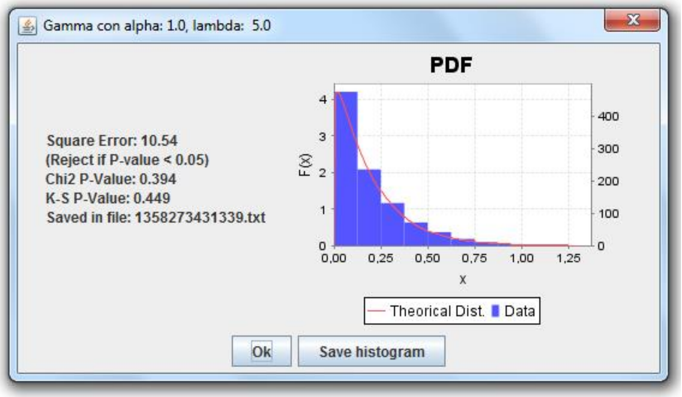

Figure 7: Goodness-of-Fit Test Result Panel

goodness-of-fit test procedures are briefly described. For this sections we also perform the tests using SSJ. In Appendix A the reader can find a brief explanation of the procedure to perform the tests developed by SSJ. As a result of the test, the software shows a new panel with a summary of the fitting and a histogram comparing the Cumulative Distribution Function (CDF) against the data histogram. The summary contains the P-Values for Kolmogorov-Smirnov and Chi-Square tests.

Example To perform a goodness-of-fit test for the dataset that we created on the previous section, we have to:

1) Open the *Random Variate Generator and Moment Calculator* Panel.

2) Change to the *Goodness-of-Fit* tab (see Figure 8).

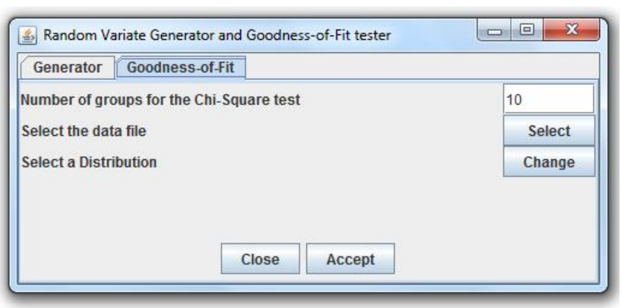

Figure 8: Goodness-of-Fit Test Panel

3) Set the number of groups for the Chi-Square test to 10.

4) Click on *Select* button and browse the data file.

5) To change the theoretical distribution click on *Change* button and select *Gamma*.

6) To perform the test, click on the *Accept* button. A results windows shown in Figure 7 should appear.

As the result of this test we can see that both Kolmogorov-Smirnov P-value and Chi-Square P-value are greater than 5%. Therefore, we cannot reject the hypothesis that the dataset follows a Gamma distribution.

2.2 Goodness-of-Fit Test for Phase-Type Distributions Panel

Description The goodness-of-fit test for PH distributions is similar to the one implemented for the common distributions. We complemented the tests for common distributions provided by SSJ by adding the methods necessaries to perform tests for PH distributions. For more information about how the test is performed see Appendix B. This features can be found in the jPhase graphical interface in the Phase Var menu, option GOF for a Phase-Type variable (see Figure 2).

This feature is designed in a panel similar to the goodness-of-fit tests for common distributions. The panel is composed of a text field to set the number of groups for the Chi-Square test, a button to select the location of the data and a list selector to choose the theoretical PH distribution (See Figure 9). The test is performed after clicking on Accept button.

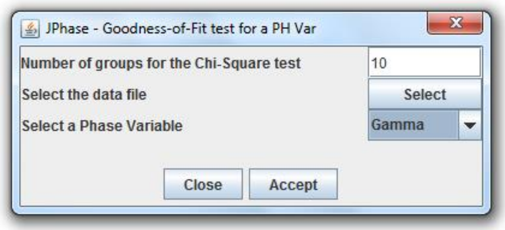

Figure 9: GOF test parameters panel

Example In this example we are going to test if a dataset distributes as a specific PH distribution. This dataset can be the same one that we create as example in Section 3.1.1 and the theoretical PH distribution is a new PH variable that we fit with jPhase using the dataset as input. To perform the test we have to follow these steps:

1) In the jPhase graphical interface create a PH variable with the name Gamma. To do it we open New Phase-Type option set a name and in the fitted variable menu we select EMPhaseFit. Click on accept.

2) Open the *GOF test for Phase-Type Distributions* panel.

3) We are going to use 10 as the number of groups for the Chi-Square test, so it is not necessary to change this parameter.

4) Click on *Select* button and choose the location of the file (in this case, the file that we created in Section 3.1.1).

5) Select the *Gamma* option.

6) Click on the *Accept* button.

After this, the panel of the Figure 10 will appear. We can see that in this case the result is that the Chi-Square P-Value and the Kolmogorov-Smornov P-Value are greater than 5%. This means that the we cannot reject the hypotesis that the dataset distributes as the PH distribution.

2.3 The PH/PH/1 Model Panel

Description jPhase's graphical interface allows users to define any number of PH distributions in order to list them, show some statistics and draw their probability density and cumulative distribution functions. In order to enhance the jPhase graphical interface this new functionality allows users to build a PH/PH/1 model which uses the list of distributions as input. The process to build this queue can be found in [Latouche et al., 1999]. The panel is composed of two lists from where the user should choose the inter-arrival time and service time.

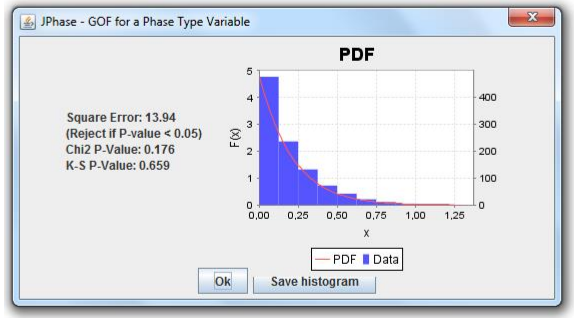

Figure 10: GOF test result panel

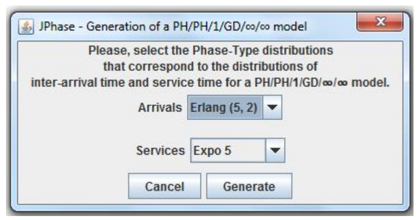

Figure 11: Generation of a PH/PH/1 model

Example In this example we will generate and analyze a PH/PH/1 queue. The time between arrivals distributes erlang with parameters $\lambda = 5, k = 2$ and the service time distributes exponentially with rate $\lambda = 5$. See [Latouche et al., 1999] for more information about these distributions. To generate the model we need to follow these steps:

1) In the *Phase Var* menu, select *Generate a PH/PH/1 Queue* option. After this, the panel shown in Figure 11 should appear.

2) This panel is composed of two lists to choose from. The first list refers to the inter-arrival time distribution and the second to the service time distribution. In the first list select *Erlang (5,2)* and in the second select *Expo 5*.

3) Click on *Generate*

As result, a panel as shown in Figure 12 appears. In it, we can see some performance measures relative to the PH/PH/1 model.

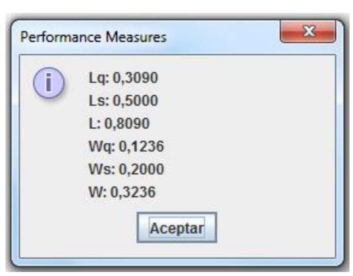

Figure 12: Performance Measures

Appendices

A Goodness-of-Fit Tests

A goodness of fit test is an analysis to test the hypothesis that a dataset distributes as a selected distribution. In assessing if a distribution is suited to a dataset there are many different tests that can be performed. Some of these tests are: the Kolmogorov-Smirnov test [Massey Jr, 1951], the Chi-Square test [Lewis and Burke, 1949], Crámer-Von Mises test [Anderson, 1962], Shapiro-Wilk [Shapiro and Francia, 1972] and Andreson-Darling test [Anderson and Darling, 1954]. We only perform the Kolmogorov-Smirnov and the Chi-Square tests in this work. The Kolmogorov-Smirnov test measure the distance of the data sample distribution with the theoretical distribution. The test builds an empirical cumulative distribution function and measures its distance with the expected one. Interested readers can refer to [Massey Jr, 1951] for more information. The Chi-Square test divides the data sample in groups and measures the distance to the expected distribution. This measure is a function of the difference between the observed number of occurrences in each group against the expected number of occurrences. For more information see [Lewis and Burke, 1949].

B Stochastic Simulation in Java

The SSJ package is a Java library for stochastic simulation [L'Ecuyer et al., 2002]. Among many features, SSJ provides facilities for generating random variates for the common distributions and performing goodness-of-fit tests. Since SSJ has coded many distributions and also many methods to generate them, we use this package in our work. This is very useful not only for generating variates but also for performing goodness-of-fit tests.

The process to perform a goodness-of-fit test in SSJ is composed of two steps:

1. Transforming all data in the file to an uniform distribution that represents the behavior of the dataset. To do this, it is necessary to use the cumulative distribution function for each data point in the file, and this array of probabilities is used as a uniform distribution.

2. Performing a Chi-Square test and a Kolmogorov-Smirnov test with the new set of uniform variates to test that the transformed data distributes uniformly.

References

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