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## Instructions for Log-Normal Distribution Workbook -

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This workbook is designed to work on Microsoft Excel Version 2010 or later; it may not work on older versions. It will certainly work on any version of Excel from a current Office 365 subscription.

**Quick-Start Guide:** It is recommended that you go through the Normal Distribution Instructions and Workbook before starting on the Log-Normal workbook because most of the instructions for Log-Normal are like what you've learned from the Normal Distribution workbook.

If you only want to view my data and the plots, there is no need for any user input. Open the file named 5\_Lognormal\_Distribution\_Workbook\_Dunham\_Sept\_2019.xlsx. This contains permeability data from Slave Field. Just click on the different worksheet tabs to see Permeability data from Facies Types one through six as described in my paper in SEPM Special Publication 109, Mountjoy Symposium 1, on a Devonian Dolostone Reservoir from Alberta Canada. In addition to the Permeability Worksheets, I have included additional sheets that compile oil and gas field resource volumes which tend to be log-normally distributed within individual basins. These are useful if you have any of your own data from new basins that you want to examine. The Field-Size Box tab shows a compilation of these data sets. Each data set comes from a Log-Normal Distribution within each basin, but the Box Plot shows that these data sets obviously come from different populations that show no overlap in their distributions. You are free to use these plots and all data analogous examples of porosity and permeability from a carbonate reservoir that has produced more than 57 million barrels of combined oil and water entirely from non-matrix vuggy porosity.

**Guide For Inputting Your Own Data:** You are encouraged to use these worksheets to examine your own data. To enter your own data, open the file named 5a\_LogNormal\_Distribution\_Workbook\_Your\_Data.xls, and save it with a date added to the file name. If you mess up the sheet, you can always go back to the original to try again. The most important user input is to copy and paste your permeability or integer data into Column A of the sheet, and DON'T FORGET TO SORT THE DATA FROM LOW TO HIGH. Also, make sure that there are no "leftover" values in Column A which might happen if you paste fewer data points than I had into Column A. Check to make sure that Column A only contains the data that you entered. Then, the only other required inputs will be to re-scale the plots to match the range of your data.

I recommend that you do not copy one Worksheet Tab and paste it into a New Worksheet Tab; this is because all the graphs and some of the cell references on the New Tab will still be referenced to cells on the Old Worksheet Tab. It is simpler to re-name the original workbook file and simply enter your new data into the re-named workbook. The instructions below should guide you through the process. Let me know if you have any questions or problems.

**User Input:** Copy and paste data into column A starting at cell A3. Formulas in the workbook will pull in up to 900 data points. If you have more than 900 data points, you will have to modify some of the formulas in the workbook as will be explained below. BE SURE TO SORT THE DATA FROM LOW TO HIGH.

Automatic functions are carried out as explained in the Normal Distribution workbook instructions. It should not be necessary to re-scale any of the plots. The graphs use a Log Scale that ranges from .001 to 100000, and this will capture the range of your input data.

The Box Plot has the distribution Mean plotted on it, as was the case for the Normal Distribution workbook. You will see that the Mean is skewed far away from the Median due to the fact that just a few large values overwhelm the majority of small values in the distribution. An additional data point called "Swanson's Mean" is shown on the plot. Swanson's Mean is often used in the petroleum industry to estimate the mean of a lognormal distribution and is defined as  $0.3 \cdot P_{10} + 0.4 \cdot P_{50} + 0.3 \cdot P_{90}$  (Hurst et al., 2000; Delfiner, 2007). It is included here. If you don't want to use it, then delete the Swanson's Mean data point.

**User Input:** The one graph that does require User Input is the Probability Plot with Cumulative Frequency on the X axis and data values on the Y axis. Some companies like this arrangement of axes for their probability plots, so it is included here. All the other plots in this workbook will automatically load the data points that you have entered into Column A, but this single plot will not display properly without User Input. First, you have to make sure that Column E and Column A are set to all the rows of data in your data set. The plot won't work right if there are more rows or fewer rows selected for input, than exist in your data set. Second, you have to go to cell AK88 and make sure that the range specified for Column BR and Column E is set to exactly the number of rows in your data set; it will not work properly if the range is set to more or fewer rows than exist in your data set. Then go to cell AL89 and set the rows to the same range.

That completes the explanation for how to use these Log-Normal Distribution spreadsheets to make your own plots with your own data. Send questions or comments to [johndunham76@gmail.com](mailto:johndunham76@gmail.com).