

Learn How to Plot and Analyze Log-Normal Distributions in Excel

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RECOMMENDED CITATION

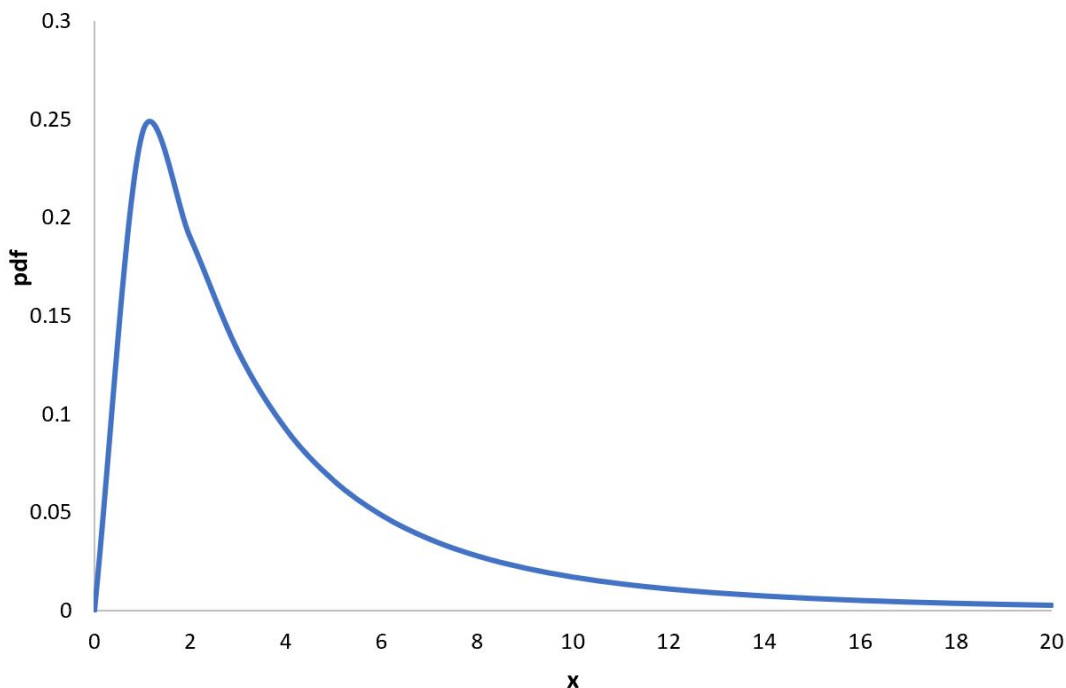
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The ability to understand and visually represent [probability distributions](#) forms the bedrock of rigorous statistics and quantitative data analysis. Among the many models statisticians employ, the [log-normal distribution](#) (LND) is especially significant due to its pervasive nature across disparate disciplines. It serves as an excellent model for [random variables](#) characterized by positivity and significant skewness, meaning the data tends to cluster near zero while having a long tail extending toward higher values. Real-world examples where the LND is frequently applied include modeling financial asset returns, income distribution levels, particle sizes in engineering, and survival times in biological studies.

Unlike the symmetrical normal distribution, the LND is defined by the property that the logarithm of the variable is normally distributed. This transformation makes it indispensable for modeling multiplicative processes where growth rates, rather than additive changes, are the key drivers. To accurately work with and communicate the implications of this distribution, analysts often need a clear graphical representation. This comprehensive guide will meticulously walk you through the process of plotting the [log-normal distribution](#) within [Microsoft Excel](#), arguably the most accessible and widely utilized tool for numerical computation and [data visualization](#).

By adhering to these detailed, step-by-step instructions, you will master the creation of an accurate and professional plot that visually captures the specific shape and characteristics of the LND defined by your chosen parameters. The final result will be a compelling visualization, similar to the illustrative plot provided below, which facilitates deeper analytical understanding and improved communication of statistical findings related to positively skewed data.

Log-Normal Distribution ($\mu=1, \sigma=1$)



Step 1: Define the Domain of X Values

The fundamental prerequisite for visualizing any continuous [probability distribution](#) is establishing the domain, or the range of [x-values](#), which represent the possible outcomes or magnitudes of the random variable. Given that the [log-normal distribution](#) is strictly defined only for positive values, it is paramount that our range begins with a value strictly greater than zero. Furthermore, because the LND is often skewed to the right, the defined [data range](#) must extend far enough along the positive axis to adequately capture the distribution's characteristic long tail, ensuring the resulting curve is smooth and complete.

To initiate this process, open a fresh [Excel](#) worksheet. We will designate Column A for our independent [x-values](#), starting in cell **A2**. To generate a smooth visual curve, the increment between successive [x-values](#) must be small and consistent. For instance, starting at 0.01 and incrementing by 0.1 (i.e., 0.01, 0.11, 0.21, and so forth) or using smaller increments like 0.05 will provide sufficient resolution. The key is to select a sequence of values that span the relevant domain, typically up to where the probability density approaches zero.

A highly efficient method for generating this series in [Excel](#) involves entering the first two or three values manually (e.g., 0.01 in **A2**, 0.11 in **A3**). Once the pattern is established, highlight these initial cells and use the [fill handle](#)--the small square located at the bottom-right corner of the

selection box--to drag the series down. This action automatically extrapolates the series, rapidly populating Column A with a sufficiently broad [range](#) of [x-values](#) necessary for plotting the [log-normal distribution](#) curve.

	A	B	C	D	E	F
1	x					
2	0.01					
3	1					
4	2					
5	3					
6	4					
7	5					
8	6					
9	7					
10	8					
11	9					
12	10					
13	11					
14	12					
15	13					
16	14					
17	15					
18	16					
19	17					
20	18					
21	19					
22	20					
23						
24						
25						

Step 2: Calculate the Probability Density (Y Values)

Following the definition of the input [x-values](#), the next critical task is to calculate the corresponding [y-values](#). In the context of continuous [probability distributions](#), these [y-values](#) represent the height of the curve, formally known as the [Probability Density Function \(PDF\)](#). The [PDF](#) does not represent a direct probability but rather the relative likelihood that a random variable will fall within an infinitesimally small interval around that specific value, making areas under the curve, not point heights, equivalent to probability.

[Excel](#) efficiently handles this complex calculation through its dedicated function, [LOGNORM.DIST](#). This function requires four arguments to fully define the desired log-normal curve:

The [x-value](#) for which the density is being calculated.

The [Mean](#) parameter (μ) of the underlying normal distribution of $\ln(x)$.

The [Standard Deviation](#) parameter (σ) of the underlying normal distribution of $\ln(x)$.

A logical value, set to [FALSE](#) to calculate the [PDF](#) (density function) or TRUE for the Cumulative Distribution Function (CDF). For plotting the curve, we must use [FALSE](#).

It is crucial to emphasize that the [mean](#) and [standard deviation](#) entered here are not the moments of the final log-normal variable itself, but rather the parameters of the underlying normal distribution of the [natural logarithm](#) of that variable. For our example, let us assume we define the [mean](#) (1) in cell **E1** and the [standard deviation](#) (1) in cell **E2**, making these parameters easily adjustable for exploring different distributions.

To compute the [PDF](#) value corresponding to the first [x-value](#) (found in cell **A2**), the following formula must be entered into cell **B2**. We utilize [absolute cell references](#) (indicated by the dollar signs, e.g., **\$E\$1**) for the [mean](#) and [standard deviation](#) parameters. This ensures that when the formula is copied down the column, these parameter cells remain fixed, while the reference to the [x-value](#) (A2) adjusts relatively to the current row.

=LOGNORM.DIST(A2, \$E\$1, \$E\$2, FALSE)

After successfully entering the formula into **B2**, hit Enter. The subsequent step is to efficiently apply this calculation across the entire [range](#) of [x-values](#). Achieve this by clicking on cell **B2** and dragging the [fill handle](#) down to the final row corresponding to your last [x-value](#) in Column A. This action instantly populates Column B with all necessary [PDF](#) values, creating the complete dataset required to plot the [log-normal distribution](#).

B2							
=LOGNORM.DIST(A2,\$E\$1, \$E\$2, FALSE)							
	A	B	C	D	E	F	G
1	x	y		Mean	1		
2	0.01	6.0061E-06		Std. Dev	1		
3	1	0.24197072					
4	2	0.1902978					
5	3	0.13233575					
6	4	0.09256496					
7	5	0.06626564					
8	6	0.04859962					
9	7	0.03643514					
10	8	0.02784847					
11	9	0.02164812					
12	10	0.01707931					
13	11	0.01365172					
14	12	0.01103902					
15	13	0.00901901					
16	14	0.00743728					
17	15	0.00618452					
18	16	0.00518201					
19	17	0.00437221					
20	18	0.00371245					
21	19	0.00317071					
22	20	0.00272266					
23							
24							

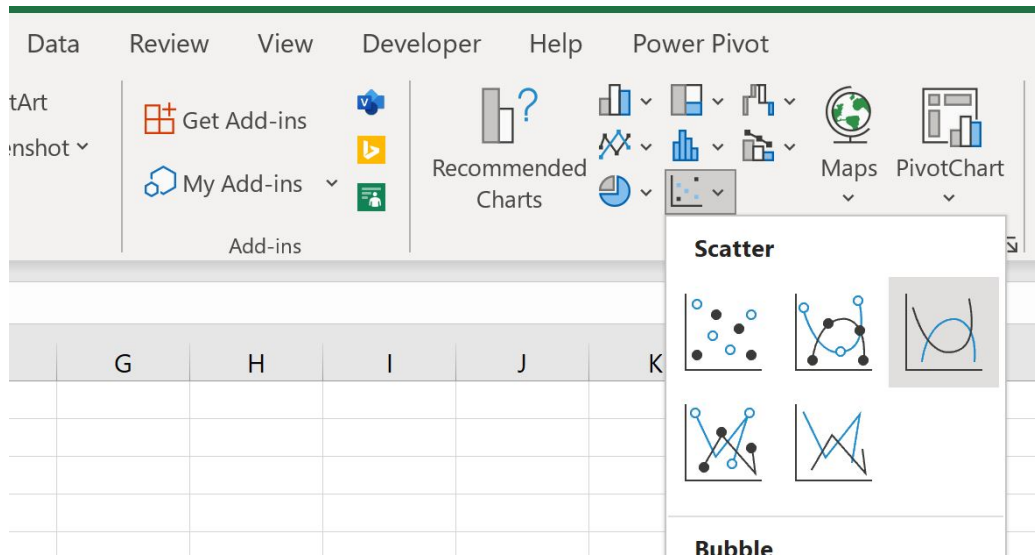
Step 3: Plot the Log-Normal Distribution Curve

With the independent [x-values](#) (the outcomes) and their corresponding dependent [y-values](#) ([PDF](#) heights) meticulously calculated, the process culminates in the visualization step. Creating a [chart](#) in [Excel](#) is essential for transforming the raw numerical data into an intuitive graphical representation that clearly displays the distribution's shape.

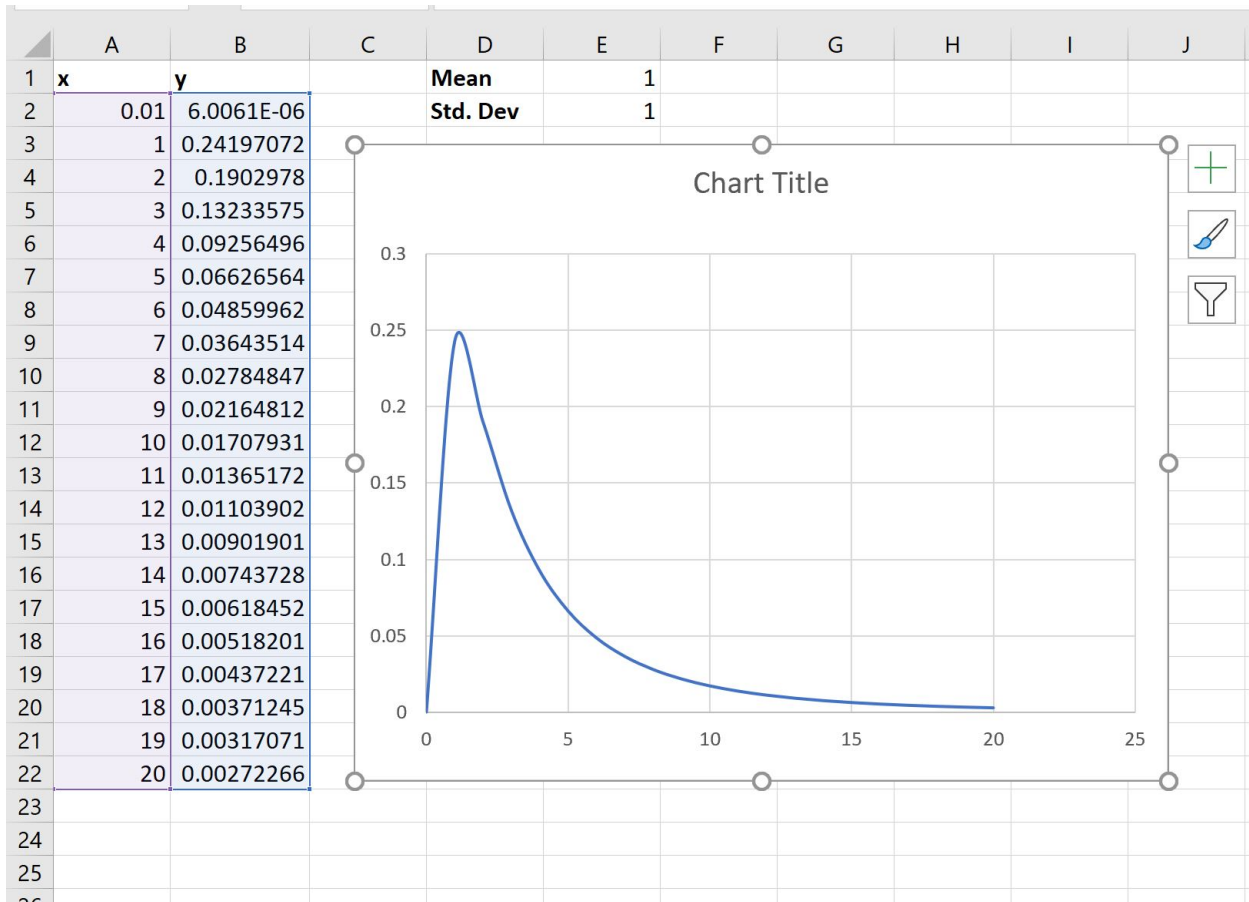
For plotting continuous functions such as the [log-normal distribution](#), the standard bar [chart](#) or line [chart](#) is inappropriate. Instead, the [Scatter with Smooth Lines](#) option is the definitive choice. This type of [chart](#) treats the data pairs (x, y) as coordinates and connects them with an interpolated, smooth curve, accurately reflecting the continuous nature of the [PDF](#). This ensures that the generated visual representation is statistically sound and visually appealing.

To begin plotting, select the entire [range](#) containing both your [x-values](#) (Column A) and [y-values](#) (Column B), including all data rows but excluding the header row if present. Once the data is

highlighted, navigate to the **Insert** tab located on the [Excel ribbon](#). Within the **Charts** section, click the **Scatter** option (usually represented by dots). From the subsequent dropdown menu, select the option labeled **Scatter with Smooth Lines**. [Excel](#) will immediately render the curve plot directly onto your worksheet.



The resulting [chart](#) will beautifully illustrate the characteristic positively skewed shape of the [log-normal distribution](#), defined by the parameters you fixed in Step 2. The [x-axis](#) represents the magnitude of the random variable, while the [y-axis](#) denotes the [PDF](#) height, visually indicating where the probability density is concentrated. Observing the smoothness of the curve confirms that an appropriate number of discrete [x-values](#) were used to simulate the continuous nature of the distribution.



Step 4: Refine the Plot for Professional Data Visualization

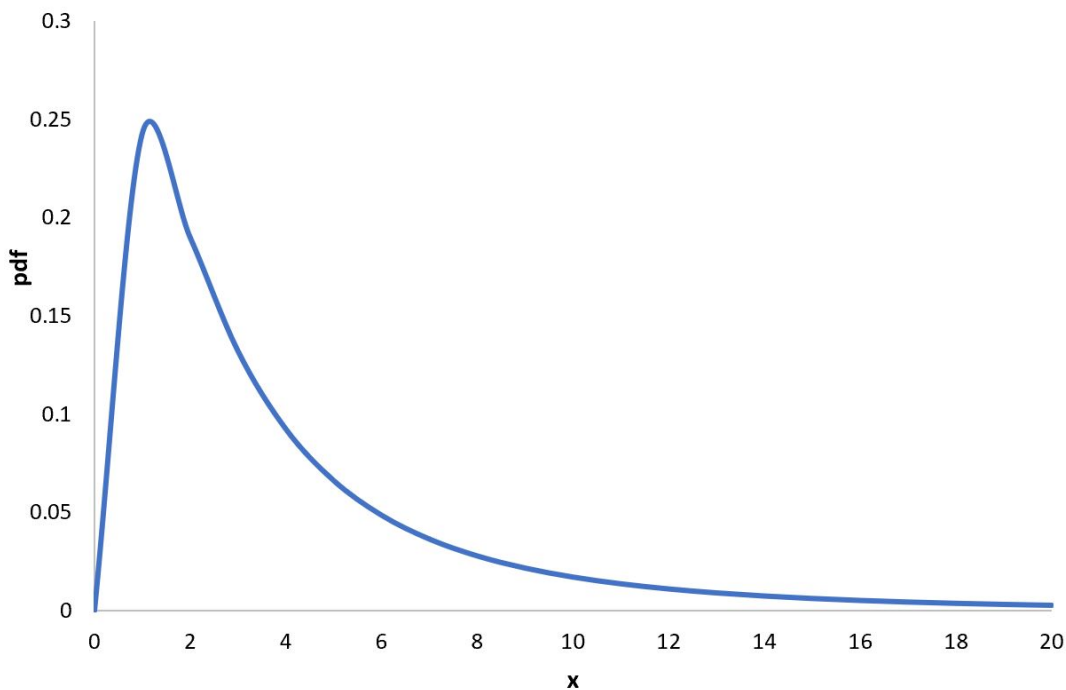
While [Excel](#) automatically generates the fundamental [chart](#) in the previous step, the raw output often lacks the polish required for professional reports or impactful presentations. Effective [data visualization](#) hinges on clarity and readability, meaning that modifying the appearance is not merely an aesthetic choice but a crucial step in analytical communication. A well-formatted plot ensures that the audience immediately understands the information being conveyed without confusion.

The first priority in refining the plot is providing context through clear labeling. Always add a descriptive [chart title](#) that encapsulates the subject matter and, ideally, notes the parameters used—for example, "Log-Normal Distribution ($\mu=1$, $\sigma=1$)". Next, ensure that both the [axes are clearly labeled](#). The [x-axis](#) should be labeled "Variable Value" or "Outcome," and the [y-axis](#) must clearly state "Probability Density" or "PDF," reinforcing the technical meaning of the curve height.

Further enhancements involve improving the overall visual cleanliness. Often, removing the default background gridlines results in a less cluttered and more focused visual field, drawing attention directly to the distribution curve itself. Additionally, consider adjusting the color, thickness, and style of the plotted line to maximize contrast and impact. By clicking on the line series, you can access

formatting options to change the line weight or color, perhaps switching to a deep blue or red to make the curve stand out against the white background. These refinements collectively elevate the plot from a simple data representation to a sophisticated and compelling visual tool for statistical analysis.

Log-Normal Distribution ($\mu=1, \sigma=1$)



Conclusion: Versatility in Statistical Plotting

By executing the steps outlined above, you have successfully leveraged the analytical power of [Excel](#) to accurately plot a [log-normal distribution](#), gaining a clear visual representation of this essential statistical concept. The methods detailed here--defining the domain, calculating the [PDF](#) using the appropriate distribution function, and visualizing the result with a smooth scatter [chart](#)--are highly adaptable.

The core technique remains the same regardless of the distribution you wish to plot. For example, to plot a Normal, Poisson, or Exponential distribution, you simply adjust the function used in Step 2 (e.g., using [NORM.DIST](#) or [POISSON.DIST](#)) while keeping the principles of defining the domain and visualizing the result consistent. This demonstrates the immense versatility of [Excel](#) as a tool for comprehensive statistical visualization and modeling, empowering users to easily explore and communicate the characteristics of various [probability distributions](#).

Additional Resources for Distribution Plotting

To further enhance your skills in plotting and understanding different statistical models, explore the following resources. These tutorials offer practical, step-by-step guidance on visualizing a range of common [probability distributions](#) in [Excel](#), expanding your analytical toolkit beyond the log-normal model.

Explore other distributions for a comprehensive understanding of statistical modeling.