Beta Distribution

| Beta Distribution | × | | Beta |
|--|----------|-------|--|
| Number of rows of data to generate: Store in column(s): | 10000000 | 40000 | |
| c1 | <u>م</u> | 30000 | |
| | Frequen | 20000 | |
| First shape parameter: 1.27 | 5 | 10000 | |
| Second shape parameter: 2.97 | 5 | | |
| Select | | 0 | |
| Help OK | Cancel | 0.00 | 0.13 0.26 0.39 0.52 0.65 0.78 0.91 C1 |

 Variable
 Mean
 StDev
 Minimum
 Maximum
 Skewness
 Kurtosis

 C1
 0.30005
 0.20013
 0.000003
 0.99679
 0.64
 -0.30

Note $0 < \mu < 1$ and $\sigma^2 < \mu(1-\mu)$

First Shape Parameter = $\alpha = \mu^*((\mu^*(1-\mu)/\sigma^2 - 1))$ Second Shape Parameter = $\beta = (1-\mu)^*((\mu^*(1-\mu)/\sigma^2 - 1))$

- 1. In **First shape parameter** α , enter a number that is greater than zero for the first shape parameter.
- 2. In **Second shape parameter** β , enter a number that is greater than zero for the second shape parameter

For example for $\mu {=} 0.3$ and $\sigma {=} 0.2$

Exponential Distribution



| Variable | Mean | StDev | Minimum | Maximum | Skewness | Kurtosis |
|----------|--------|-------|---------|---------|----------|----------|
| C1 | 130.01 | 30.00 | 100.00 | 557.31 | 2.00 | 5.99 |

1. Scale = σ

2. Threshold = μ - σ

For example for μ =130 and σ =30

Scale = 30 Threshold = 100

Gamma Distribution



 Variable
 Mean
 StDev
 Minimum
 Maximum
 Skewness
 Kurtosis

 C1
 30.001
 3.001
 15.603
 48.717
 0.20
 0.06

Scale parameter =
$$\theta = \frac{\sigma^2}{\mu}$$

Shape parameter = $\frac{\mu}{\theta}$

For example, for μ = 30 and σ = 3

Shape = 30/0.3 = 100

Scale = 3*3/30 = 0.3

Normal

| Normal Distribution | | × | | | | Normal | | | |
|---------------------|-------------------------------------|----------|-------|--------|-----------|---------|------|-----------|------|
| C1 N | Number of rows of data to generate: | 1000000 | 140 | 00 | | hili. | 1. | | |
| S | Store in column(s): | | 120 | 00 | | | | | |
| • | c1 | A | 100 | 00 | | 1 | | | |
| | | | 80 JC | 00- | | | | | |
| | | - | reque | 00 | 1 | | | h. | |
| | | | E 60 | 00 | | | | | |
| M | Mean: 30 | | 40 | 00 | | | | | |
| S | Standard deviation: 3 | | 20 | 00 | | | | | |
| Select | | | | 0 20.8 | 23.4 26.0 | 28.6 | 31.2 | 33.8 36.4 | 39.0 |
| Help | ОК | Cancel | | 20.0 | 20.0 | 23.0 C1 | 5112 | 55.0 50.4 | 55.0 |

| Variable | Mean | StDev | Minimum | Maximum | Skewness | Kurtosis |
|----------|--------|-------|---------|---------|----------|----------|
| C1 | 29.997 | 3.004 | 15.758 | 44.814 | 0.00 | 0.00 |

Mean = μ = 30

Standard deviation = σ = 3

Iterating on distribution parameters to obtain desired mean and standard deviation

The parameters for the following distributions only have suggested starting points and you must iterate to find the parameters that produce the desired mean and standard deviation. The example below used the Largest Extreme Value distribution and a desired mean of 30 and a standard deviation of 3.

The **Location** parameter is approximately the peak of a left skewed distribution with the hint that it is less than the mean.

The Scale parameter is approximately equal to the standard deviation. The starting point for location is 30 while the starting point for Scale is 3.

Use Minitab's Calc/Random Data/Largest Extreme Value... feature, see Figure 1.

The dialog box opens, see Figure 2.

Set the "Number of rows of data to generate" at 1,000,000 or 10,000,000. (Red Arrow).

Type "C1" in the "Store in Column(s):" (Green Arrow).

Enter 30 for the "Location" parameter. (Orange Arrow).

Enter 3 for the "Scale" parameter. (Blue Arrow).

See Figure 3.

Press OK and the data is created in column 1, see Figure 4

Run the Display Descriptive Statistics command to view the mean and standard deviation values. See Figure 5.

Enter "**C1**" in the "**Variables**" box, see Figure 6. Press OK to see the results.

Figure 7 shows the results.

The mean is 31.730 and is larger than the entered **Location** parameter of 30. I'd make the next iteration equal to 30-1.73 or 28.27.

The standard deviation is 3.846 and is larger than the entered **Scale** parameter of 3. I'd make the next iteration equal to 3-0.846 or 2.154 and run the Display Descriptive Statistics command to view the new mean and standard deviation estimates. See Figure 8.

I overshot both the mean and standard deviation and after a few more iterations I arrive at **Location** = 28.65 and **Scale** = 2.36, see Figure 9.

Follow the same instructions for these other distributions.



Figure 1 Minitab Calculate Random Data Feature

| Largest Extreme Value | Largest Extreme Value Distribution $	imes$ | | | | | | | | | | |
|-----------------------|--|-----------|------------------|--------|--|--|--|--|--|--|--|
| | Number of | f rows of | data to generate | : | | | | | | | |
| | Store in co | olumn(s): | | | | | | | | | |
| | | | | • | | | | | | | |
| | | | | | | | | | | | |
| | | | | - | | | | | | | |
| | | | | | | | | | | | |
| | Location: | 0.0 | | | | | | | | | |
| | Scale: | 1.0 | | | | | | | | | |
| Select | | | | | | | | | | | |
| Help | | | ОК | Cancel | | | | | | | |

Figure 2 Largest Extreme Value Dialog



Figure 3 Completed Dialog

| 🏨 Minitab - Untitled | | |
|--|-------|---------|
| File Edit Data Calc Stat Graph View He | lp As | sistant |
| 🗎 🖶 😓 🔏 🖻 龍 🗲 🔿 🖉 | H. 44 | 00 |
| Navigator | + | C1 |
| | | |
| | 1 | 37.2807 |
| | 2 | 29.1027 |
| | 3 | 35.9988 |
| | 4 | 31.0372 |
| | 5 | 26.3973 |
| | 6 | 30.7421 |
| | 7 | 36.2488 |
| | 8 | 28.0521 |
| | 9 | 33.6597 |
| | 10 | 36.7061 |
| | 11 | 47.5994 |
| | 12 | 29.6886 |
| | 13 | 33.7865 |
| | 14 | 36.6616 |
| | 15 | 29.8974 |
| | 16 | 28.4881 |
| | 17 | 27.3623 |
| | 18 | 31.5874 |

Figure 4 Minitab Data Pane



Figure 5 Run the Display Descriptive Statistics Command

| Display Descriptive Statistics \times | | | | | | | | | | | |
|---|------------------|----------------|--|--|--|--|--|--|--|--|--|
| C1 | ⊻ariables: C1 | • | | | | | | | | | |
| | | • | | | | | | | | | |
| <u>By</u> variables (optional): | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | • | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Select | Statistics | <u>G</u> raphs | | | | | | | | | |
| Help | QK | Cancel | | | | | | | | | |

Figure 6 Display Descriptive Statistics Dialog

Statistics N N* Mean SE Mean StDev Minimum Q1 Median Q3 Maximum Variable 1000000 0 31.730 0.00122 3.846 C1 21.368 29.018 31.098 33.736 85.164

Figure 7 First Iteration Results

Statistics

| Variable | N | N* | Mean | SE Mean | StDev | Minimum | Q1 | Median | Q3 | Maximum |
|----------|----------|----|--------|----------|-------|---------|--------|--------|--------|---------|
| C1 | 10000000 | 0 | 29.513 | 0.000874 | 2.763 | 22.295 | 27.565 | 29.059 | 30.955 | 65.475 |

Figure 8 Second Iteration Results

| Statistic | cs | | | | | | | | | |
|-----------|---------|----|--------|----------|-------|---------|--------|--------|--------|---------|
| Variable | Ν | N* | Mean | SE Mean | StDev | Minimum | Q1 | Median | Q3 | Maximum |
| C1 | 1000000 | 0 | 30.013 | 0.000957 | 3.027 | 21.864 | 27.879 | 29.515 | 31.590 | 69.553 |

Figure 9 Final Iteration

Largest Extreme Value Distribution

| Largest Extreme Value Distri | ibution | | × | | | La | rgest Ext | reme Va | lue | | | |
|------------------------------|-----------------|-------------------|---------|----------------------|----|----|-----------|----------|-----|----|----------------------|----|
| Num | ber of rows of | data to generate: | 1000000 | 80000 | | | | | | | | |
| Store | e in column(s): | | | 70000 | | | | | | | | |
| c1 | | | ۵ | 60000 | | | | | | | | |
| | | | | ک ^{و 50000} | | | | | | | | |
| | | | - | anba. | | | | | | | | |
| | | | | 30000 | | | | | | | | |
| Locat | ition: 28.65 | | | 20000 | | | | | | | | |
| Scale | e: 2.35 | | | 10000 | | | | | | | | |
| Select | | | | 0 | | | | | | | Mitthe approximation | |
| Help | | ОК | Cancel | | 24 | 27 | 30 | 33 C1 | 36 | 39 | 42 | 45 |

VariableMeanStDevMinimumMaximumSkewnessKurtosisC130.0133.02721.86469.5531.142.40Location \approx Peak $\approx < \mu$ Scale $\approx \sigma$

Start with known μ and σ and iterate to better estimates.

For example for μ =30 and σ =3

Location ≈ 28.65 Scale ≈ 2.35

Logistic Distribution



 Variable
 Mean
 StDev
 Minimum
 Maximum
 Skewness
 Kurtosis

 C1
 30.003
 2.983
 7.038
 55.657
 -0.01
 1.19

 $\begin{array}{l} \text{Location} \approx \text{Peak} \approx \mu \\ \text{Scale} \approx \sigma \end{array}$

Start with known μ and σ and iterate to better estimates.

For example for μ =30 and σ =3

Location ≈ 30 Scale ≈ 1.645

Smallest Extreme Value

| Smallest Extreme Valu | ue Distribution × | | Smallest Extreme Value |
|-----------------------|--|-----------|--|
| | Number of rows of data to generate: 10000000 | 40000 | 0 |
| | Store in column(s): | | 0 |
| | | Frequency | o |
| | Location: 31.35 | 10000 | 0 |
| Select Help | OK Cancel | 0 | 0 18.2 20.8 23.4 26.0 28.6 31.2 33.8 C1 |

 Variable
 Mean
 StDev
 Minimum
 Maximum
 Skewness
 Kurtosis

 C1
 30.000
 2.999
 -6.761
 37.689
 -1.14
 2.39

Location \approx Peak $\approx > \mu$ Scale $\approx \sigma$

Start with known μ and σ and iterate to better estimates.

For example, for μ =30 and σ =3

Location ≈ 31.35 Scale ≈ 2.34

Weibull

| Weibull Distribution | | | × | | | | We | eibull | | | |
|----------------------|------------------------|--------------|---------|----------------|------|------|------|------------|------|------|------|
| | Number of rows of data | to generate: | 1000000 | 70000 | | | | | | | |
| | Store in column(s): | | | 60000 | | | | | | | |
| | c1 | | | 50000 | | | | -/ | | | |
| | | | | A0000 | | | | | | | |
| | | | • | Bredu 30000 | | | | | | | |
| | Shape parameter: | 11.77 | - | 20000 | | | | | | | |
| | Scale parameter: | 31.3 | | 10000 | | | | | | | |
| Select | Threshold parameter: | 0.0 | | 10000 | | | | | | | |
| Help | | ОК | Cancel | 0 | 20.3 | 23.2 | 26.1 | 29.0 C1 | 31.9 | 34.8 | 37.7 |

 $\begin{tabular}{|c|c|c|c|c|} \hline Variable & Mean & StDev & Minimum & Maximum & Skewness & Kurtosis \\ \hline C1 & 29.972 & 3.091 & 7.269 & 39.883 & -0.70 & 0.75 \\ \hline & Shape \approx \sigma \\ & as & Shape \uparrow \mu \downarrow \\ & Scale & Parameter \approx \mu \\ \hline \end{tabular}$

Start with known μ and σ and iterate to better estimates.

For example for μ =30 and σ =3

Shape ≈ 11.77 Scale ≈ 31.3