

# Package ‘bcc’

May 7, 2026

**Title** Beta Control Charts

**Version** 1.5

**Description** Applies Beta Control Charts to defined values. The Beta Chart presents control limits based on the Beta probability distribution, making it suitable for monitoring fraction data from a Binomial distribution as a replacement for p-Charts. The Beta Chart has been applied in three real studies and compared with control limits from three different schemes. The comparative analysis showed that: (i) the Beta approximation to the Binomial distribution is more appropriate for values confined within the [0, 1] interval; and (ii) the proposed charts are more sensitive to the average run length (ARL) in both in-control and out-of-control process monitoring. Overall, the Beta Charts outperform the Shewhart control charts in monitoring fraction data. For more details, see Ângelo Márcio Oliveira Sant’Anna and Carla Schwengber ten Caten (2012) <[doi:10.1016/j.eswa.2012.02.146](https://doi.org/10.1016/j.eswa.2012.02.146)>.

**License** GPL-3

**Encoding** UTF-8

**RoxygenNote** 7.2.3

**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2024-06-10 17:40:06 UTC

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apply\_shewhart\_rules *Apply Shewhart Control Rules*

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### Description

Identifies points in a control chart that violate Shewhart control rules. These rules help to determine if a process is out of control and requires corrective action.

### Usage

```
apply_shewhart_rules(data, limits, type, sizes = NULL)
```

### Arguments

data	A numeric vector of data values to be analyzed.
limits	A list containing the control limits, specifically the lower control limit (LCL) and upper control limit (UCL).
type	An integer representing the type of control chart. There are two possible types: 1 for discrete data (such as proportions or counts) and 2 for continuous data.
sizes	An optional numeric vector of sample sizes. This parameter is typically required for type 1 charts.

### Value

A vector of indices corresponding to data points that violate the Shewhart control rules.

### Examples

```
# Example with discrete data
data_values <- c(0.1, 0.2, 0.15, 0.3, 0.25)
sample_limits <- list(lcl=0.05, ucl=0.25, center=0.15)
apply_shewhart_rules(data_values, sample_limits, type=1)

# Example with continuous data
data_values <- c(0.55, 0.60, 0.65, 0.70, 0.75)
sample_limits <- list(lcl=0.50, ucl=0.70, center=0.60)
apply_shewhart_rules(data_values, sample_limits, type=2)
```

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**bcc***Beta Control Charts*

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**Description**

Creates and displays a Beta control chart using the specified data, sample sizes, and type. This is the main function for generating control charts in this package.

**Usage**

```
bcc(data, sizes = NULL, type, title = NULL)
```

**Arguments**

<code>data</code>	A numeric vector of data values to be plotted on the control chart.
<code>sizes</code>	An optional numeric vector of sample sizes. This parameter is required for type 1 charts, which are designed for discrete data.
<code>type</code>	An integer representing the type of control chart. There are two possible types: 1 for discrete data (such as proportions or counts) and 2 for continuous data.
<code>title</code>	An optional string specifying the title of the plot.

**Details**

The Beta Chart presents control limits based on the Beta probability distribution. It is used for monitoring fraction data from a Binomial distribution as a replacement for p-Charts. The Beta Chart has been applied in three real studies, demonstrating its effectiveness. Comparative analysis revealed that: (i) the Beta approximation to the Binomial distribution is more appropriate for values confined within the  $[0, 1]$  interval; and (ii) the proposed charts are more sensitive to the average run length (ARL) in both in-control and out-of-control process monitoring. Overall, the Beta Charts outperform the Shewhart control charts for monitoring fraction data.

**Value**

A plot of the Beta control chart.

**Examples**

```
# Example for type 1 chart with discrete data
data <- c(0.12, 0.18, 0.14, 0.28, 0.22)
sizes <- c(101, 98, 110, 105, 95)
bcc(data, sizes, type=1, title="Beta Control Chart for Discrete Data")

# Example for type 2 chart with continuous data
data <- c(0.59, 0.67, 0.61, 0.70, 0.59)
bcc(data, type=2, title="Beta Control Chart for Continuous Data")

# Example changing the title of the chart
data <- c(0.07, 0.13, 0.21, 0.25, 0.19)
```

```
sizes <- c(52, 49, 51, 53, 48)
bcc(data, sizes, type=1, title="Custom Title: Beta Control Chart for Discrete Data")
```

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calculate\_limits      *Calculate Control Limits*

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### Description

Calculates control limits for control charts using given data and sizes. Supports both type 1 (discrete data) and type 2 (continuous data) control charts.

### Usage

```
calculate_limits(data, sizes = NULL, type)
```

### Arguments

data	A numeric vector of data values.
sizes	An optional numeric vector of sample sizes. Required for type 1 charts.
type	An integer representing the type of control chart. There are two possible types: 1 for discrete data and 2 for continuous data.

### Value

A list containing the lower and upper control limits, and the center.

### Examples

```
# Example for type 2 chart with continuous data
data_values <- c(0.55, 0.60, 0.65, 0.70, 0.75)
calculate_limits(data_values, type=2)
```

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plot\_control\_chart      *Plot Control Chart*

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### Description

Generates and plots a control chart using the given data, sizes, type, and control limits.

### Usage

```
plot_control_chart(data, type, limits, title, sizes = NULL)
```

**Arguments**

<code>data</code>	A numeric vector of data values.
<code>type</code>	An integer representing the type of control chart (either 1 or 2).
<code>limits</code>	A list containing the lower and upper control limits, and the center.
<code>title</code>	A string for the plot title.
<code>sizes</code>	A numeric vector of sample sizes.

**Value**

A plot of the control chart.

**Examples**

```
data <- c(0.12, 0.18, 0.14, 0.28, 0.22)
sizes <- c(101, 98, 110, 105, 95)
limits <- list(lcl = 4.03915, ucl = 16.0, center = 0.216)
plot_control_chart(data, type=1, limits=limits, title="Sample Control Chart", sizes=sizes)
```

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