Package: p3d (via r-universe)

October 25, 2026

Title Interactive 3D Visualization of p-Value Surfaces

Version 0.1.0

Description Provides interactive three-dimensional visualization of p-value surfaces for single-sample t-tests. Enables simultaneous exploration of effect size, sample size, and significance level, making the continuous nature of p-values and the moderating effect of sample size visually apparent. Includes both interactive ('rgl', 'plotly') and static (persp()) rendering options. The p-value surface is based on the approach of Infanger and Schmidt-Trucksäss (2019) <doi:10.1002/sim.8293>.

License GPL (>= 3)

Encoding UTF-8

Roxygen list(markdown = TRUE)

URL https://github.com/ahmetkutuk1/p3d, https://ahmetkutuk1.github.io/p3d/

BugReports https://github.com/ahmetkutuk1/p3d/issues

Config/roxygen2/version 8.1.0

Suggests knitr, plotly, rgl, rmarkdown, testthat (>= 3.0.0)

Config/testthat/edition 3

Depends R (>= 4.1.0)

VignetteBuilder knitr

Repository https://ahmetkutuk1.r-universe.dev

Date/Publication 2026-10-15 18:16:18 UTC

RemoteUrl https://github.com/ahmetkutuk1/p3d

RemoteRef HEAD

RemoteSha 76612b6efcbed247d4d812796a34306ca0c95e42

Contents

p_curve_2d 2
p_surface 3
plot_p_static 4
plot_p_surface 5

Index **7**

`p_curve_2d` *Compute 2D p-value curve for a fixed sample size*

Description

Computes the p-value as a function of effect size (Cohen's d) for a single, fixed sample size. This is the 2D analogue of `p_surface` and is provided for comparison with existing 2D visualization packages such as **pvaluefunctions**.

Usage

```
p_curve_2d(d, n, alpha = 0.05)
```

Arguments

`d`	Numeric vector of effect sizes (Cohen's d).
`n`	Single sample size. Must be >= 2.
`alpha`	Significance level. Default: 0.05.

Details

The p-value is computed as:

$$p(d) = 2\left[1 - F_{t(n-1)}(d\sqrt{n})\right]$$

Value

A data frame with columns:

d Effect sizes.

p Two-sided p-values.

significant Logical; whether `p < alpha`.

Examples

```
# 2D curve for n = 30
curve_30 <- p_curve_2d(d = seq(-2, 2, 0.1), n = 30)
head(curve_30)

# Compare with 3D surface
surface <- p_surface(d = seq(-2, 2, 0.1), n = c(10, 30, 100))
```

`p_surface` *Compute p-value surface for single-sample t-test*

Description

Computes the p-value of a single-sample t-test as a function of effect size (Cohen's d) and sample size (n). Returns a grid of p-values suitable for 3D visualization.

Usage

```
p_surface(d, n, alpha = 0.05)
```

Arguments

`d`	Numeric vector of effect sizes (Cohen's d). Typical range: -2 to 2.
`n`	Numeric vector of sample sizes. Must be >= 2. Typical range: 5 to 200.
`alpha`	Significance level for the critical effect size. Default: 0.05.

Details

The p-value is computed using the formula:

$$p(d, n) = 2\left[1 - F_{t(n-1)}(d\sqrt{n})\right]$$

where $F_{t(n-1)}$ is the cumulative distribution function of the t-distribution with $n - 1$ degrees of freedom.

The critical effect size at level α is:

$$d_{crit}(n) = \frac{F^{-1}_{t(n-1)}(1 - \alpha/2)}{\sqrt{n}}$$

Value

A list with the following elements:

d The input vector of effect sizes.

n The input vector of sample sizes.

p A matrix of p-values with dimensions `length(d)` x `length(n)`.

d_crit A numeric vector of critical effect sizes for each sample size at level `alpha`.

alpha The significance level used.

grid A data frame with the full grid of (d, n, p) combinations.

Examples

```
# Small example
result <- p_surface(d = seq(-1, 1, 0.1), n = c(10, 30, 100))
str(result)

# Typical use
result <- p_surface(d = seq(-2, 2, 0.05), n = seq(5, 200, 5))
image(result$d, result$n, result$p)
```

`plot_p_static` *Static 2D perspective plot of p-value surface*

Description

Plots the output of `p_surface` using base R's `persp` function. This produces a static 3D perspective plot with no external dependencies, making it suitable for PDF output, journal figures, and CRAN checks.

Usage

```
plot_p_static(
  surface,
  theta = 30,
  phi = 20,
  col = "steelblue",
  shade = TRUE,
  alpha = 0.05
)
```

Arguments

`surface`	A list returned by `p_surface`.
`theta, phi`	Viewing angles in degrees. See `persp` for details. Defaults: `theta = 30`, `phi = 20`.
`col`	Color palette for the surface. Either a single color or a vector of colors matching the number of $d \times n$ grid cells.
`shade`	Logical; if `TRUE` (default), the surface is shaded using `persp`'s shading.
`alpha`	Significance level. A horizontal plane at $p = \alpha$ is overlaid on the surface. Default: 0.05.

Details

Unlike `plot_p_surface`, which requires **rgl** or **plotly**, this function uses only base R graphics. It is ideal for inclusion in static documents such as PDF articles and printed reports.

Value

Invisibly returns the input `surface` object. Called for its side effect (a plot).

Examples

```
# Compute surface
surface <- p_surface(d = seq(-2, 2, 0.1), n = seq(5, 200, 5))

# Static perspective plot
plot_p_static(surface)

# Different viewing angle
plot_p_static(surface, theta = 45, phi = 30)
```

---

plot_p_surface *Interactive 3D visualization of p-value surface*

Description

Plots the output of `p_surface` as an interactive three-dimensional surface. Two rendering engines are supported: `"rgl"` (default, interactive window) and `"plotly"` (HTML widget, ideal for R Markdown / Quarto documents).

Usage

```
plot_p_surface(
  surface,
  engine = c("rgl", "plotly"),
  alpha = 0.05,
  col = NULL,
  show_boundary = TRUE
)
```

Arguments

`surface`	A list returned by `p_surface`.
`engine`	Character; either `"rgl"` (default) or `"plotly"`. Determines the rendering backend.
`alpha`	Significance level. A horizontal plane at $p = \alpha$ is overlaid on the surface. Default: 0.05.
`col`	Color palette for the surface. If `NULL` (default), a built-in palette is used.
`show_boundary`	Logical; if `TRUE` (default), the intersection curve between the surface and the α-plane is drawn.

Details

The 3D surface shows the p-value as a function of both effect size (d) and sample size (n). The α-plane visualizes the conventional significance threshold. The intersection curve marks the boundary between "significant" and "non-significant" regions.

For `engine = "rgl"`, the **rgl** package must be installed. For `engine = "plotly"`, the **plotly** package must be installed. Both are listed in `Suggests`.

Value

Invisibly returns the input `surface` object. Called for its side effect (a plot).

Examples

```
# Compute surface (non-interactive part)
surface <- p_surface(d = seq(-2, 2, 0.1), n = seq(5, 200, 5))
str(surface, max.level = 1)

# Interactive visualization (only in interactive sessions)
if (interactive()) {
  # rgl engine (interactive window)
  plot_p_surface(surface)

  # plotly engine (HTML widget)
  plot_p_surface(surface, engine = "plotly")
}
```

Index

p_curve_2d, 2
p_surface, *2*, 3, *4*, *5*
persp, *4*
plot_p_static, 4
plot_p_surface, *4*, 5