



Uso da linguagem R para análise de dados de inventário florestal

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Laboratório de Estatística e Geoinformação

Departamento de Estatística · UFPR

15 de julho de 2020

O que é o R?

Definição

- ▶ É uma linguagem de programação livre e de código aberto (um projeto GNU).
- ▶ É um ambiente de software para computação estatística e gráficos.
- ▶ <https://www.r-project.org/about.html>.



Características

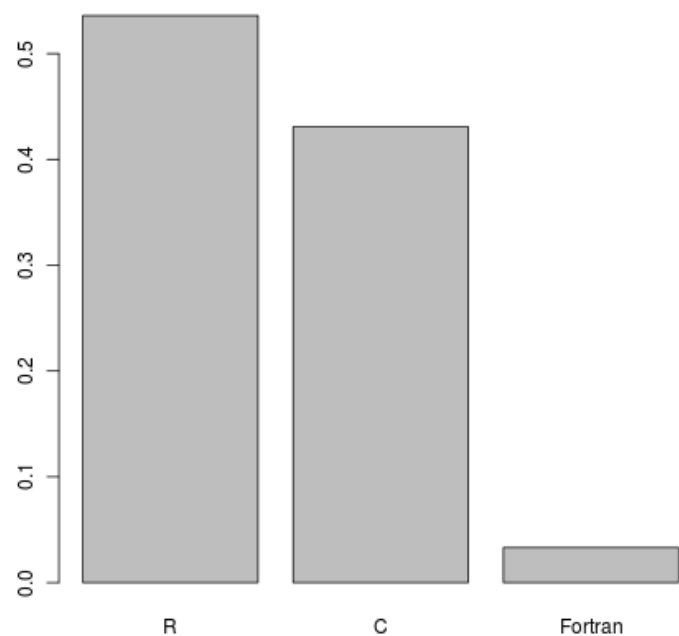
O R fornece amplo ferramental de estatística além de:

- ▶ Inúmeros recursos gráficos.
- ▶ Extensível: coleção de mais de 15 mil pacotes oficiais no **CRAN**.
- ▶ Interoperabilidade & Interconectividade: APIs/drivers para outros softwares¹.
- ▶ Multiplataforma: Linux, Mac OS, Windows, Android.
- ▶ Escalabilidade e código compilado: C e Fortran².

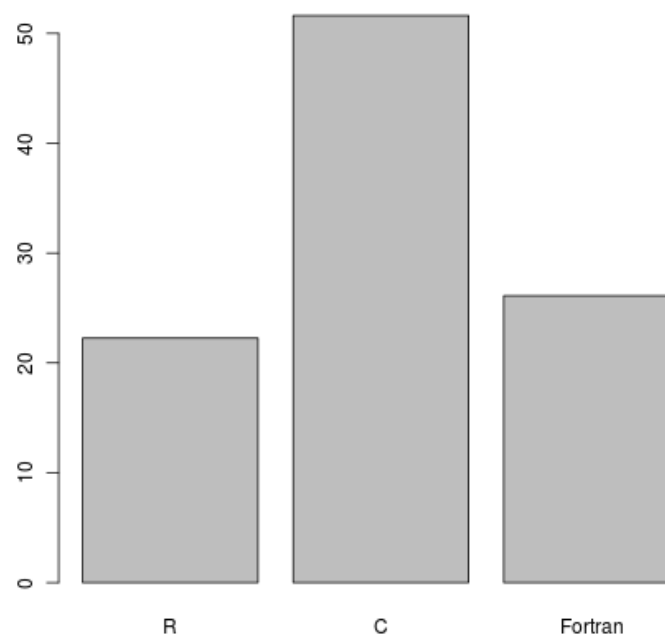
O R contém C e Fortran

Parte do código fonte do *R base* está em C e Fortran³.

Percent of Core R Sourcecode Files



Percent of Core R Lines of Code



Os 3 princípios da linguagem R

Segundo John Chambers^{4 5}.

Three Principles (Section 1.1)

Object Everything that exists in R is an object.

Function Everything that happens in R is a function call.

Interface Interfaces to other software are part of R.

Quem usa o R?

Quem usa o R?

- ▶ Tem imensa popularidade acadêmica e científica.
 - ▶ Universidades e escolas.
 - ▶ Institutos de pesquisa.
 - ▶ Órgãos governamentais.
- ▶ Com a Era da Informação ou Era Big Data:
 - ▶ Start Ups.
 - ▶ Empresas privadas.
 - ▶ Grandes empresas de informação.

R nas empresas

Empresas que usam o R para análise de dados⁵.



Apoiadores

R Consortium⁴: suporte para a comunidade R.



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Breve história do R

Os criadores



- ▶ Desenvolvido por Ross Ihaka e Robert Gentleman.
- ▶ É uma implementação da linguagem S.
- ▶ University of Auckland, New Zealand.
- ▶ Surtiu em 1993.



- ▶ Implementação da Linguagem S de John Chambers.
- ▶ Hoje desenvolvido pelo *the R Development Core Team*.
- ▶ Cross-plataforma (Linux, MAC, Windows).
- ▶ FOSS: *free and open source software*.
- ▶ > 15 mil pacotes oficiais no **CRAN**.
- ▶ Centenas em desenvolvimento no GitHub.

“R”efletions

“R”efletions: um pouco da história e experiências com o R - Paulo Justiniano Ribeiro Jr · Conferência no 1º R Day (2018).

"R"eflexões: um pouco de história e experiências com o R - Paulo Justiniano Ribeiro Jr



0 Projeto R



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The R Project for Statistical Computing

Getting Started

R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. To [download R](#), please choose your preferred [CRAN mirror](#).

If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

News

- [R version 3.6.1 \(Action of the Toes\)](#) has been released on 2019-07-05.
- useR! 2020 will take place in St. Louis, Missouri, USA.
- [R version 3.5.3 \(Great Truth\)](#) has been released on 2019-03-11.
- The R Foundation Conference Committee has released a [call for proposals](#) to host useR! 2020 in North America.
- You can now support the R Foundation with a renewable subscription as a [supporting member](#)
- The R Foundation has been awarded the Personality/Organization of the year 2018 award by the professional association of German market and social researchers.

<https://www.r-project.org/>

Como obter o R?



CRAN

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About R

[R Homepage](#)

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The Comprehensive R Archive Network

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- [Download R for Linux](#)
- [Download R for \(Mac\) OS X](#)
- [Download R for Windows](#)

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

Source Code for all Platforms

Windows and Mac users most likely want to download the precompiled binaries listed in the upper box, not the source code. The sources have to be compiled before you can use them. If you do not know what this means, you probably do not want to do it!

- The latest release (2019-07-05, Action of the Toes) [R-3.6.1.tar.gz](#), read [what's new](#) in the latest version.

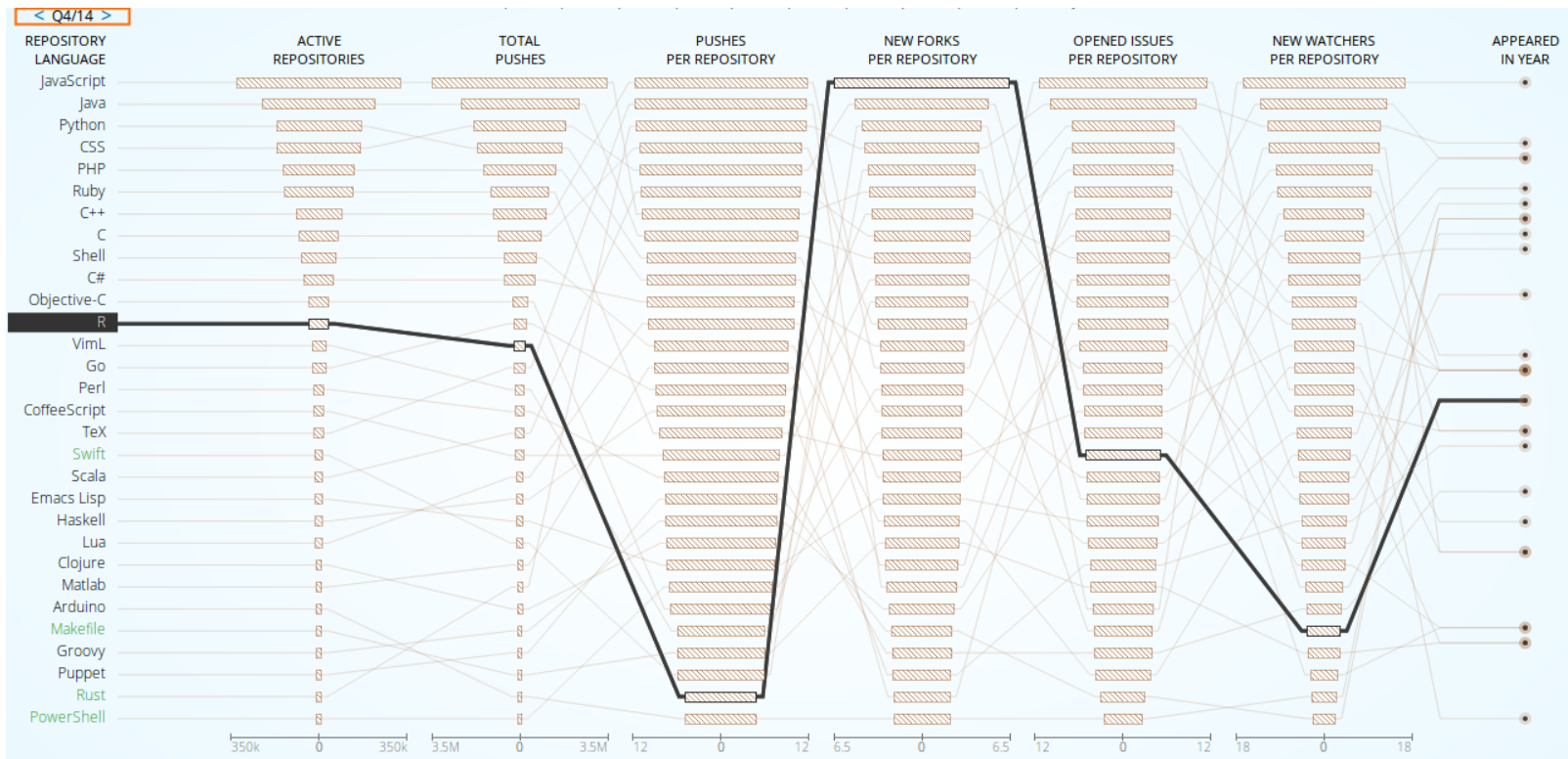
Visão por tarefas

Topics	
Bayesian	Bayesian Inference
ChemPhys	Chemometrics and Computational Physics
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Databases	Da Multivariate Multivariate Statistics
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Hydrology	Hy SpatioTemporal Handling and Analyzing Spatio-Temporal Data
MachineLearning	Ma Survival Survival Analysis
MedicalImaging	Me TeachingStatistics Teaching Statistics
MetaAnalysis	Me TimeSeries Time Series Analysis
	WebTechnologies Web Technologies and Services
	gR gRaphical Models in R

<https://cran.r-project.org/web/views/>

Popularidade do R

Ranking no GitHub em 2014





















<https://github.info/>

Ranking no GitHub hoje

9	C	4.035% (+0.378%)	
10	Ruby	3.042% (+0.015%)	
11	Shell	1.925% (-0.189%)	
12	Swift	1.038% (-0.303%)	
13	Objective-C	0.932% (-0.110%)	
14	Kotlin	0.932% (+0.285%)	^
15	Scala	0.686% (-0.160%)	v
16	Rust	0.635% (-0.173%)	v
17	Lua	0.610% (+0.128%)	
18	R	0.410% (+0.048%)	^
19	Groovy	0.360% (+0.025%)	^
20	Perl	0.340% (+0.031%)	^
21	Elixir	0.292% (+0.032%)	^
22	Emacs Lisp	0.274% (+0.016%)	^

<https://madnight.github.io/github/#/issues/2019/1>

Repositórios de maior destaque

Repositories	Developers	Language: R	Date range: This month
 R toolkit for single cell genomics R 509 310 Built by 		★ 45 stars this month	
 An implementation of the Grammar of Graphics in R R 3,921 1,481 Built by 		★ 58 stars this month	
 dplyr: A grammar of data manipulation R 3,003 1,106 Built by 		★ 36 stars this month	
 A curated list of awesome R packages, frameworks and software. R 3,600 1,206 Built by 		★ 50 stars this month	
 A collection of interactive courses for the swirl R package. R 2,967 6,207 Built by 		★ 31 stars this month	
 Easy interactive web applications with R R 3,480 1,508 Built by 		★ 39 stars this month	

<https://github.com/trending/r?since=monthly>

As listas de discussão oficiais

What List?				
1)	org.r-project.r-help	374,710	13) org.r-project.r-packages	721
2)	org.r-project.r-devel	56,322	14) org.r-project.r-sig-fedora	568
3)	org.r-project.r-sig-geo	26,599	15) org.r-project.r-sig-wiki	398
4)	org.r-project.r-sig-mixed-models	17,199	16) org.r-project.r-sig-jobs	381
5)	org.r-project.r-sig-finance	14,504	17) org.r-project.r-sig-epi	348
6)	org.r-project.r-sig-mac	12,497	18) org.r-project.r-sig-robust	248
7)	org.r-project.r-sig-ecology	5,810	19) org.r-project.r-sig-gr	170
8)	org.r-project.r-sig-phylo	5,359	20) org.r-project.r-announce	161
9)	org.r-project.r-sig-debian	3,066	21) org.r-project.r-sig-s	32
10)	org.r-project.r-sig-db	1,506	22) org.r-project.r-sig-networks	27
11)	org.r-project.r-sig-gui	1,230	23) org.r-project.r-sig-mediawiki	25
12)	org.r-project.r-sig-teaching	820	24) org.r-project.r-sig-qa	25

R-BR · A lista nacional oficial de R

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1 2 3 4 ... 139

Topics (4863)	Replies	Last Post	Views
[R-br] Problema para criar um GeoTIFF a partir da divisão um raster RGB by R-br mailing list	0	Jul 17 by R-br mailing list	8
[R-br] Processamento paralelo x pacote by R-br mailing list	0	Jul 02 by R-br mailing list	3
[R-br] Criar colunas by R-br mailing list	0	Jul 02 by R-br mailing list	8
[R-br] Processamento paralelo x pacote by R-br mailing list	0	Jul 01 by R-br mailing list	5
[R-br] Modelos Mistos - Distribuição Poisson by R-br mailing list	1	Jul 01 by R-br mailing list	4
[R-br] Geolocalizacao by R-br mailing list	2	Jun 30 by R-br mailing list	9
[R-br] Mensagem de erro no pacote ExpDes by R-br mailing list	1	Jun 26 by R-br mailing list	2
Re: [R-br] Modelos Mistos - Distribuição Poisson by R-br mailing list	0	Jun 25 by R-br mailing list	1
[R-br] Aplicação de métodos de dados faltantes no ambiente R by R-br mailing list	2	Jun 25 by R-br mailing list	6

<http://www.leg.ufpr.br/doku.php/software:rbr>

R no Stackoverflow

Stack Overflow Trends

See how technologies have trended over time based on use of their tags since 2008, when Stack Overflow was founded. Enter up to 15 tags to compare growth and decline.

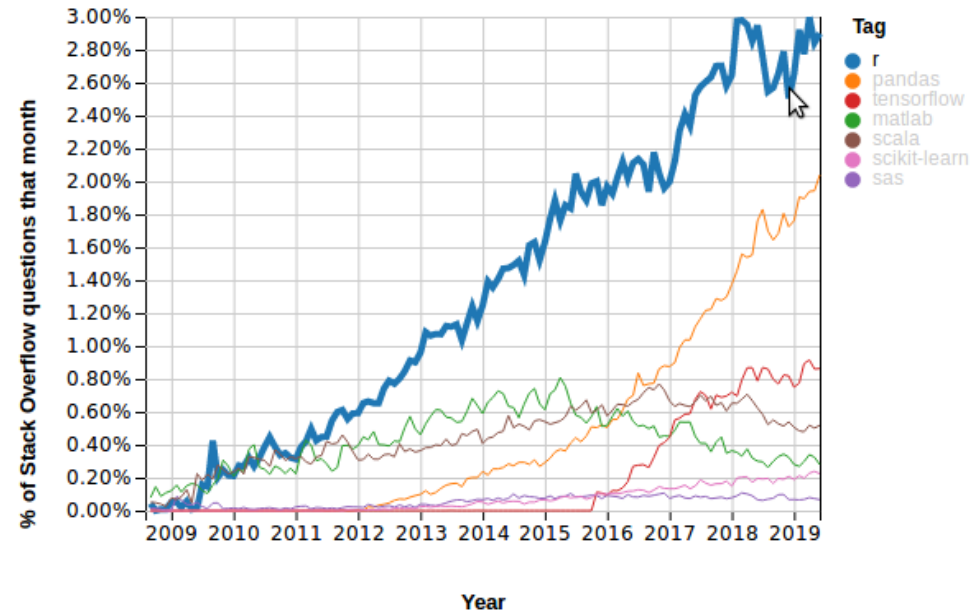
Tags:

r x pandas x matlab x tensorflow x sas x
scala x scikit-learn x

Don't know what tags to look at? Try one of our presets:

- Most Popular Languages (TIOBE Index for May 2017)
- Operating Systems
- Mobile Operating Systems
- Javascript Frameworks
- Smaller Javascript Frameworks
- Closed-source Browser Plugins
- Data Science and Big Data
- Apache Open-source Projects

For more on this tool and what you can learn from it, see our [blog post](#).



Oportunidades de emprego no Brasil

The screenshot shows the LinkedIn search interface. At the top, the LinkedIn logo is on the left, followed by a navigation bar with 'Jobs', 'R Programming', and 'Brazil' (highlighted with an orange box). To the right are 'Join now' and 'Sign in' buttons. Below the navigation bar are filter buttons: 'Date Posted', 'Experience Level', 'Job Type', 'Company', and 'More Filters'. A search bar shows '134 Results for "R Programming in Brazil" (3 new)'. The results list includes:

- Senior Project Engineer - Data Scientist** at Choice Technologies Holding Sàrl, Rio de Janeiro Area, Brazil. Key Knowledge, Skills and Experience - Minimum qualifications. 10 years of relevant work experience (e.g., as a ...). 3 weeks ago · Easy Apply.
- Programa de Férias ou Estágio - Analytics** at Accenture Brasil, São Paulo, BR. This new vacation program offers the professional the opportunity to know and be part of the Analytics world and experience the reality ... 1 day ago.

The job details for 'Senior Project Engineer - Data Scientist' are shown in a larger view on the right, including the company logo, job title, location, and an 'Easy Apply' button. The post is attributed to Fernanda Casado, Human Resources Director at Choice Technologies Holding Sàrl.

<https://www.linkedin.com/jobs/search?keywords=R%20Programming>

Algumas funcionalidades

Recursos gráficos

- ▶ Gráficos estáticos com `ggplot2`⁵.
- ▶ Recursos interativos⁶.
- ▶ Estatísticas da Hanseniase no Paraná: <http://www.leg.ufpr.br/~paulojus/hanseniasse/>.
- ▶ Vídeos sobre recursos gráficos: <https://youtu.be/KvWCppWip7I>.

Dashboards com R

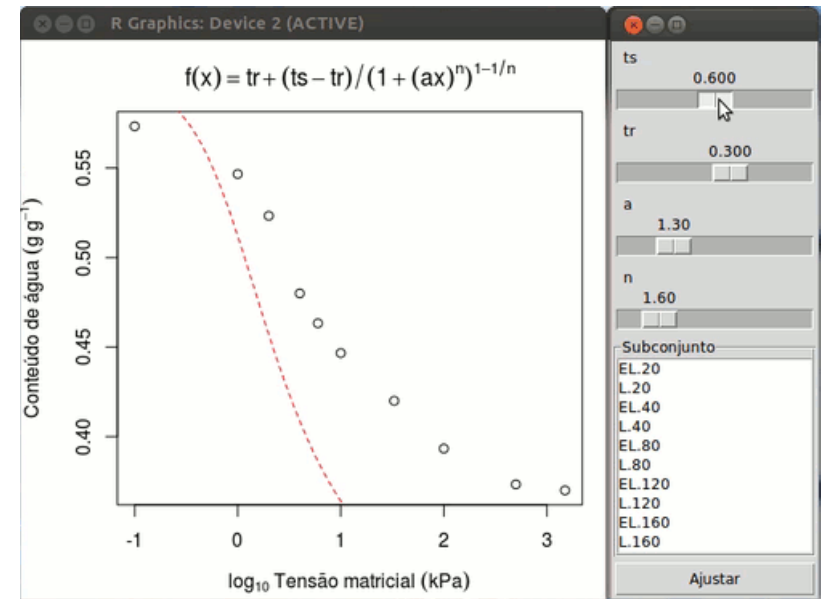
- ▶ Dashboards com R feitos em Shiny⁸.

Exemplos de Dashboards

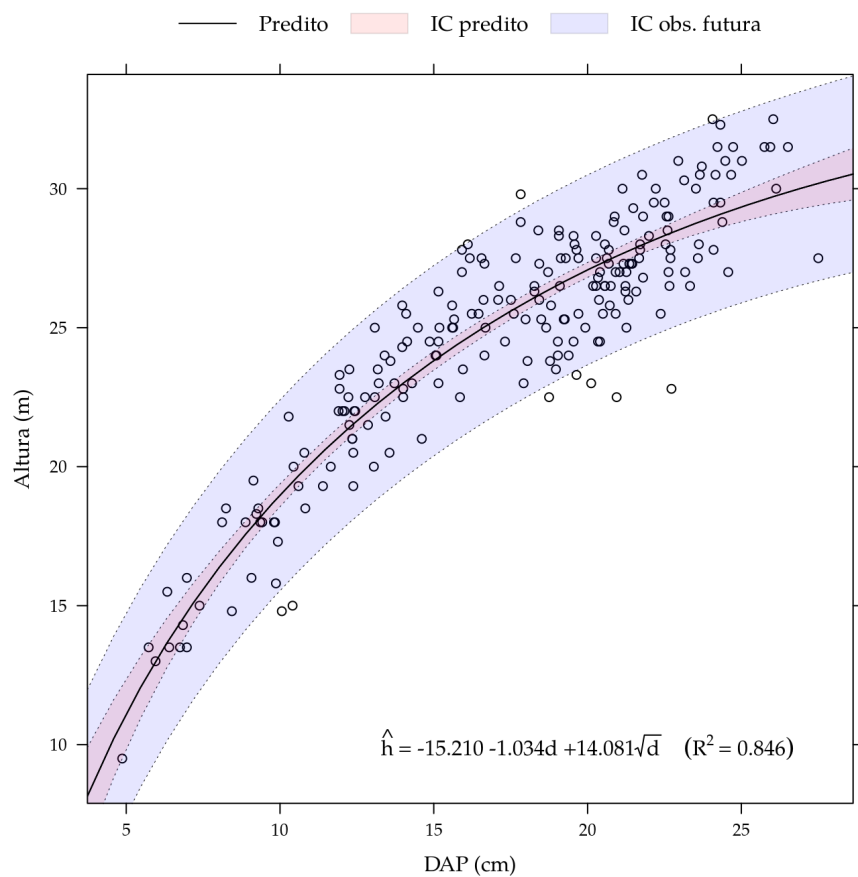
- ▶ Monitoramento de Covid19 - Brasil e mundo: <http://shiny.leg.ufpr.br/elias/covid19time/>.
- ▶ Monitoramento de Covid19 - Estados brasileiros: <http://leg.ufpr.br/~wagner/covid/Estados.html>.

Métodos estatísticos

- ▶ Ajuste de modelos estatísticos e de aprendizado de máquina.
- ▶ Procedimentos de simulação Monte Carlo (reamostragens e afins)^a.
- ▶ Métodos multivariados, métodos não paramétricos, etc, etc, etc.



Ajuste de modelo hipsométrico



<http://leg.ufpr.br/~walmes/cursoR/mgest/1medidas-influen.html>

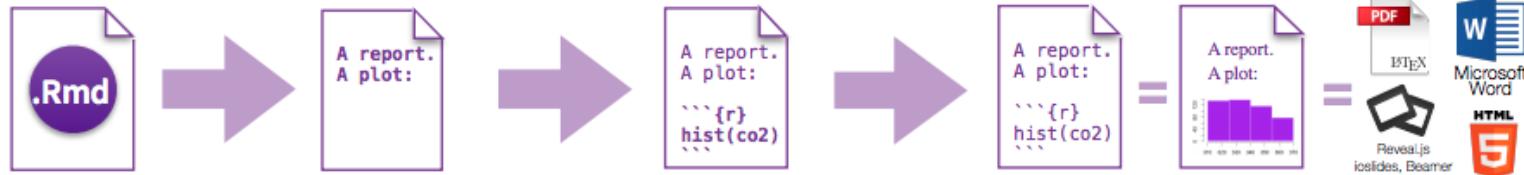
Documentos dinâmicos

i. Open - Open a file that uses the .Rmd extension.

ii. Write - Write content with the easy to use R Markdown syntax

iii. Embed - Embed R code that creates output to include in the report

iv. Render - Replace R code with its output and transform the report into a slideshow, pdf, html or ms Word file.



https://angus.readthedocs.io/en/2018/rmarkdown_rnaseq.html

Tutorias em vídeo

- ▶ Introdução ao Rmarkdown · Fernando Mayer.
- ▶ Pesquisa reproduzível com R Markdown · Fernando Mayer.

Supremo em Ação

- ▶ Relatório anual: <https://www.cnj.jus.br/pesquisas-judiciarias/supremo-em-acao/>
- ▶ Aplicação Web: <http://dpj.cnj.jus.br/supremo-em-acao/>.



Material didáticos indicados

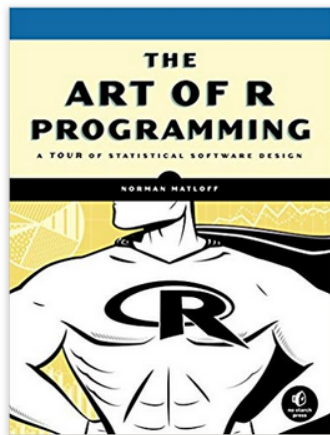
The Art of R Programming: A Tour of Statistical Software Design 1st Edition

by Norman Matloff (Author)



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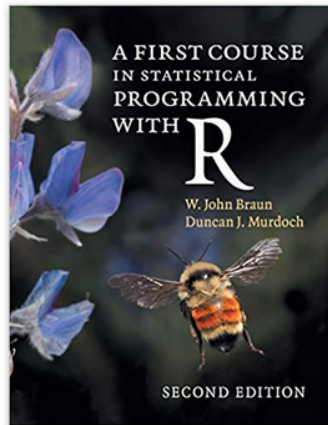
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A First Course in Statistical Programming with R 2nd Edition

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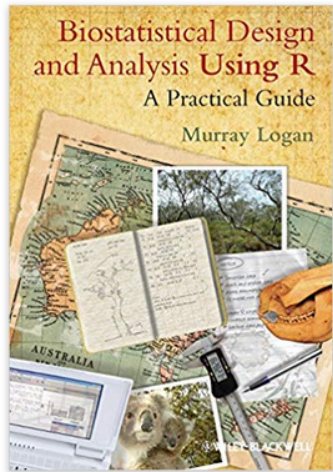
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Biostatistical Design and Analysis Using R: A Practical Guide 1st Edition

by Dr Murray Logan (Author)


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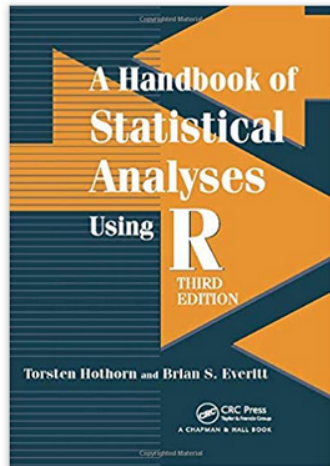
Introdutório com aplicações.

A Handbook of Statistical Analyses using R, Third Edition 3rd Edition

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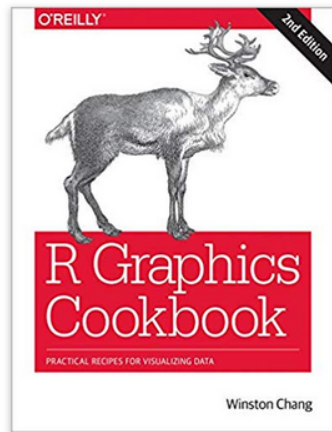
Intermediário com aplicações.

R Graphics Cookbook: Practical Recipes for Visualizing Data 2nd Edition

by [Winston Chang](#) (Author)

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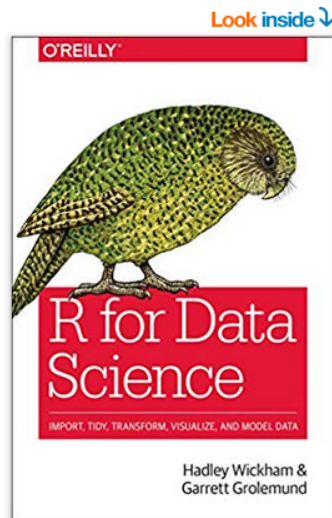
Visualização de dados.

R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition

by [Hadley Wickham](#) (Author), [Garrett Grolemund](#) (Author)

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Manipulação e visualização de dados.

Hands-On Programming with R: Write Your Own Functions and Simulations

by [Garrett Grolemond](#) (Author), [Hadley Wickham](#) (Foreword)

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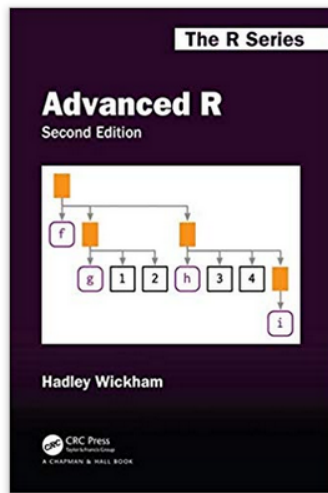
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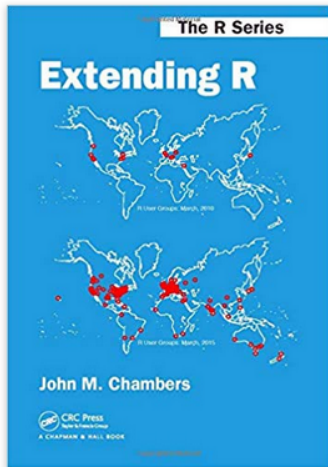
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R avançado.

Conteúdo de R para Engenharia Florestal

Forest Analytics with R



© 2011

Forest Analytics with R

An Introduction

Authors: **Robinson**, Andrew P., **Hamann**, Jeff D.

Uses real datasets that provide detailed and realistic examples of forestry data handling and analysis

Introdução ao R: Aplicações Florestais (livro)

Introdução ao R: Aplicações Florestais

Deivison Venicio Souza

Thiago Wendling Goncalves de Oliveira

Luani Rosa de Oliveira Piva

Joielan Xipaia dos Santos

Carlos Roberto Sanquetta

Ana Paula Dalla Corte



Dendro Blog (blog)

- ▶ Dendro Blog: <https://labdendro.com/blog/>.
- ▶ Eng. Florestal [Pedro Higuchi](#).
- ▶ Professor na Universidade Estadual de Santa Catarina (UDESC).

Dendro Blog

Sobre trabalhos científicos, idéias, links, análises de dados, R e a vida acadêmica

[Sobre o autor](#) [Rotinas – R](#)

Rotina R para inferir sobre a influência da resolução filogenética no NRI

11 de maio de 2016

R, tutorial

estrutura

...

A resolução de árvores filogenéticas pode influenciar o cálculo de métricas de estruturação filogenética de comunidades biológicas, de forma que este aspecto tem



ARQUIVOS

Selecionar o mês ▾

Mensuração Florestal (blog)

- ▶ Mensuração Florestal: <http://www.mensuracaoflorestal.com.br>.
- ▶ Eng. Florestal **Carlos Pedro Boechat Soares**
- ▶ Professor na Universidade Federal de Viçosa (UFV).

The screenshot shows the website interface for 'MENSURAÇÃO FLORESTAL'. At the top, there is a dark navigation bar with the site name on the left, a 'SOBRE O SITE' button in the center, and a search bar on the right with the placeholder text 'Procurar no site...' and a 'BUSCAR' button. Below the navigation bar is a breadcrumb trail: 'HOME / TEMAS ATUAIS / USO DE REDES NEURAIAS ARTIFICIAIS NA DETERMINAÇÃO DE FATORES DE EMPILHAMENTO'. The main content area features the article title 'Uso de Redes Neurais Artificiais na Determinação de Fatores de Empilhamento' in blue. Below the title is a short paragraph: 'A quantificação do volume de madeira que chega aos pátios das empresas de transformação, bem como a quantidade estocada neles, é fundamental para o planejamento das atividades florestais no campo e na própria empresa.' To the right of the main content is a sidebar menu titled 'CONTEÚDOS' with three items: 'Temas Atuais', 'Estatística', and 'Dendrometria'.

Pacote R florestal

florestal: Results for Forest Inventories

The functions return sampling parameters for forest inventories with tables and graphics. Methods used in the package refers to Pellico e Brena (1997)

<<https://bit.ly/2BDbHJI>>.

Version: 0.1.1
Depends: R (\geq 3.5.0)
Imports: [ggplot2](#), [data.table](#), [BiodiversityR](#), [cowplot](#), [flextable](#), [officer](#),
[dplyr](#), [tidyr](#)
Published: 2020-07-07
Author: Igor Cobelo Ferreira
Maintainer: Igor Cobelo Ferreira <cobelo.igor at gmail.com>
License: [GPL \(\$\geq\$ 3\)](#)
NeedsCompilation: no
CRAN checks: [florestal results](#)

Pacote R ForestGapR

ForestGapR: Tropical Forest Gaps Analysis

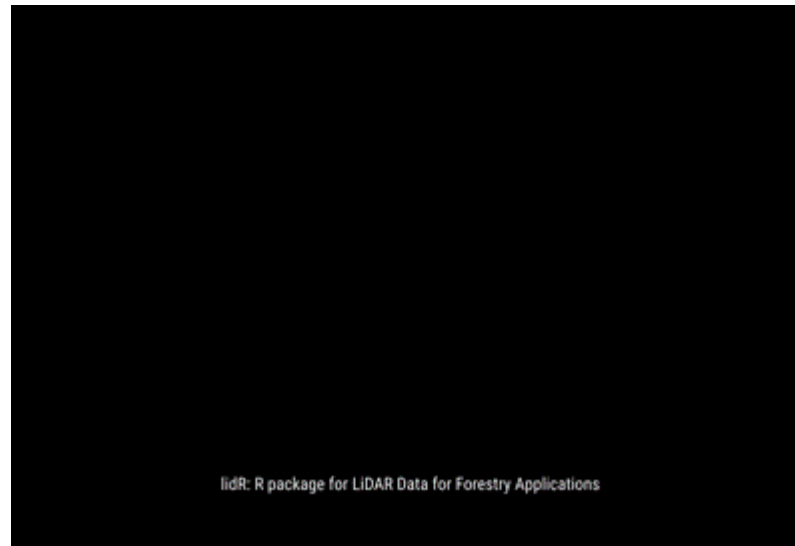
Set of tools for detecting and analyzing Airborne Laser Scanning-derived Tropical Forest Canopy Gaps.

Version: 0.0.2
Depends: R (\geq 3.4.0)
Imports: [raster](#), [igraph](#), [VGAM](#), [sp](#), graphics, stats, [viridis](#), [rgeos](#), [spatstat](#)
Published: 2019-01-07
Author: Carlos Alberto Silva [aut, cre, cph], Ekena Rangel Pinagé [ctb] (Reviews the documentation), Midhun Mohan [ctb] (Reviews the documentation), Danilo Roberti Alves de Almeida [ctb] (Reviews the documentation), Eben North Broadbent [ctb] (Reviews the documentation), Wan Shafrina Wan Mohd Jaafar [ctb] (Reviews the documentation), Daniel de Almeida Papa [ctb] (Reviews the documentation), Adrian Cardil [ctb] (Reviews the documentation), Ruben Valbuena [cph, ctb], Carine Klauberg [ctb] (Reviews the documentation)
Maintainer: Carlos Alberto Silva <carlos_engflorestal at outlook.com>
License: [GPL-3](#)
NeedsCompilation: no
CRAN checks: [ForestGapR results](#)

Outros pacotes

- ▶ **forestry**: Reshape Data Tree.
- ▶ **ForestTools**: Analyzing Remotely Sensed Forest Data.
- ▶ **rFIA**: Space-Time Estimation of Forest Variables using the FIA Database.
- ▶ **FIESTA**: An R estimation tool for FIA analysts.
- ▶ **tidyFIA**: Assemble Forest Inventory and Analysis (FIA) Data for Analysis.
- ▶ **rForest**: Forest Inventory and Analysis.

Outros pacotes



- ▶ **forestr**: Ecosystem and Canopy Structural Complexity Metrics from LiDAR.
- ▶ **lidR**: Airborne LiDAR Data Manipulation and Visualization for Forestry Applications.

Considerações Finais

Considerações Finais

- ▶ R é uma linguagem e ambiente para computação estatística e gráficos livre e de código aberto.
- ▶ É extensível, escalável, interoperável com várias outras linguagens/softwarewares.
- ▶ É cada vez mais popular na comunidade acadêmica.
- ▶ Tem sido adotado exponencialmente na comunidade profissional para atividades de análise de dados.
- ▶ O R pode ser empregado em várias etapas do Investário Florestal:
 - ▶ Tratamentos dos dados.
 - ▶ Confecção dos mapas e demais visualizações.
 - ▶ Elaboração do relatório reproduzível.
 - ▶ Disponibilização de conteúdo via APIs e dashboards.
 - ▶ Ajuste de modelos estatísticos e predição.
 - ▶ Uso de métodos de aprendizado de máquinas.

Agradecimentos

- ▶ À comissão organizadora deste evento.
- ▶ À todos os participantes.

Contato

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- ▶ walmes@ufpr.br.
- ▶ @walmeszeviani.