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R for agronomist and natural resources professionals

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Abstract— R is extremely powerful and versatile data analysis software that is freely available for download off the worldwide web. It is omni-platform and nearly the most popular language. By now, R has 5361 packages, 452 bloggers, 21 Special Interest Group, and something like 156 books and other publications devoted to it. It has some noticeable books in ecology and natural resources sciences. Some important packages in ecology, hydrology and climatology, GIS and RS, time series, Bayesian and spatial statistic review in this paper.

Keywords— Book, Natural Resources, package, R.

I. INTRODUCTION

When choosing analytical software to use, there are various reasons to consider. Does it run natively on your PC (Omni-platform)? Does the software provide all the methods, models and techniques you need? If not, how extensible is it? Does it fully support the style (programming vs. point-and-click) that you like to use? Are its visualization options (e.g. static vs. interactive) adequate for your problems? Does it provide your interested outputs (e.g. cut & paste vs. LaTeX integration)? Does it handle large enough data sets (satellite, spatial data, and large matrixes)? Do your coworkers use it so you can easily share data, programs and codes? Can you afford it (commercial or open source)? Software that is popular and growing probably meets the needs of many people well, however that certainly doesn't mean it will meet yours.

Open source software such as R [1] is extremely powerful and versatile data analysis software that is freely available for download off the worldwide web. R is calling from other softwares and in some cases, surpasses commercial statistical software and graphing packages.

Rexer Analytics survey during 2009 showed that for data mining/analytic tools, R comes out on top, followed by SAS and SPSS. Cumulative number of topics for R at support web sites on March 8, 2012 is 10,606 (Stack overflow discussion) and 1612 (cross validated discussion) (Quoara.com data collected 9/13/2011.). Until Feb 2014, R has 5361 packages (available.packages {utils}), 452 bloggers [2] and 21 Special Interest Group (SIG) mailing lists [4]. R is also 15th of top programming languages amongst all programming languages in latest RedMonk ranking (January 2014) [6].

The TIOBE Community Programming Index ranks the popularity of programming languages, but from a programming language perspective rather than as analytical software [7]. It extracts measurements from blogs, entries in Wikipedia, books on Amazon, and search engine results, and combines them into a single index. In January 2012, they rank R in 24th place and SAS at 31st. However, in July 2012, the two reversed positions with SAS in 24th place and R in 28th. In September 02, 2013, KDDNuggets completed its annual poll of top languages for analytics, data mining and data science, and just as in the prior two years the R language was ranked the most popular (used by 61% of KDnuggets readers), Python (39%), and SQL (37%). SAS was stable at around 20%[9].

R and S-PLUS are both implementations of the S language and so are in the most direct competition. From the view of Internet discussion, S-PLUS is experiencing a significant decline. In 2011, half the months showed fewer than ten notices on its list. Many of them were simply conference announcements.

From the point of number of books devoted to R software, books and other publications related to S or R are 156 [11]. Some R books related to agricultural sciences natural resources including:

Spatial Statistics and Modeling [12], *Forest Analytics with R*. Use R![13], *A Primer of Ecology with R*. Use R [14], *Mixed Effects Models and Extensions in Ecology with R* [15], *Applied Spatial Data Analysis with R* [16], Statistical Data Analysis Explained: Applied Environmental Statistics with R [17], Ecological Models and Data in R [18], Statistical Methods for Environmental Epidemiology with R.

Model-based Geostatistics [19], Spatial Data Analysis in Ecology and Agriculture Using R [17] and Statistical Analysis of Environmental Space-Time Processes [20].

Thus, wide adoption of R by biologists, petrologist, geologist and managers in the field of agriculture and natural resources may result in substantial cost-savings to natural resource

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agencies.
R can analyze spatial data, mathematical and statistical analysis on spatial data with no need of visualization. Some R packages providing an interface to GISs including R and GRASS, SPGRASS6 , R and SAGA, RSAGA [16]. R can also run ArcGIS geoprocessing tools through the R package named RpyGeo.
In task views (Analysis of Ecological and Environmental Data), every one can easily download and install almost all packages in natural resources at once by typing install .packages("ctv"),library("ctv"),install.views("Environmetrics") in R software or related to IDEs [22].
Interested packages in spatial sciences including agronomy and ecology, Hydrology and climatology, petrology and related fields are categorized as bellow:
I.Some packages in agronomy and ecology
ade4: Analysis of Ecological Data[23], agridat: Agricultural datasets [24], AIGIS: Agricultural datasets [3], BSagri: Title Statistical methods for safety assessment in agricultural field trials [25], eco: for Ecological Inference [5], ecodist : Dissimilarity-based analysis functions including ordination and Mantel test functions [8], ecolMod: A practical guide to ecological modeling [10], ecoreg: Ecological regression using aggregate and individual data [26], coenoflex: Simulates the composition of samples of vegetation according to gradient-based vegetation theory [21], EcoTroph: modelling marine and freshwater ecosystems [27], seem :Simulates of ecological models [28].
II. and clim Some packages in hydrology
Bclim: takes pollen/time data from lake cores and produces a Bayesian posterior distribution of palaeoclimate [29], clim.pact: Climate analysis and empirical-statistical downscaling [30], climatol: Some Tools for Climatology[31], crn: Downloads and Builds datasets for Climate Reference Network [32], dcv: performs several conventional Cross-validation statistical methods for climate-growth model in the climate reconstruction from tree rings, including SignTest statistic, Reduction of Error statistic, Product Mean Test, Durbin-Watson statistic etc [33], fossil: palaeoecologists and palaeobiogeographers [34], palaeoSig: Tests if quantitative palaeoenvironmental reconstructions are statistically significant [35], EcoHydRology: A community modeling foundation for Eco-Hydrology [36], FAdist: Distributions that are sometimes used in hydrology [37], hydroGOF: Goodness-of-fit functions for comparison of simulated and observed hydrological time series [38], HydroMe: estimates the parameters in infiltration and water retention models by curve-fitting method [39], hydroTSM: S3 functions for management, analysis, interpolation andplotting of time series used in hydrologyand related [40], spi: Compute SPI index (SPI) [41], topmodel: Implementation of the hydrological model TOPMODEL in R [42], TUWmodel: The model is a lumped conceptual rainfall-runoff model,following the structure of the HBV model [43], wasim: Helpful tools for data processing and visualisation of results of the hydrological model WASIMETH [44], waterData: Retrieval, Analysis, and Anomaly Calculation of Daily Hydrologic Time Series Data [45].
III. Some packages in Geographic Information (GIS) and Remote Sensing (RS)
adehabitatMA: A collection of tools to deal with raster maps [46], biOps :Image processing and analysis [47], gdistance: Calculate distances and routes on geographic grids [48], geoRglm: generalised linear spatial models [49], geotools: Geo tools [50], ggmap: spatial visualization with Google Maps, OpenStreetMap, Stamen Maps [51], GISTools: Some mapping and spatial data manipulation tools - in particular drawing choropleth maps [52], Grid2Polygons: converts a spatial object from class SpatialGridDataFrame to spatialPolygonsDataFrame [53], landsat: Radiometric and topographic correction of satellite imagery [54], OpenStreetMap: Accesses high resolution raster maps [55], plotKML: Visualization of spatial and spatio-temporal objects in Google Earth [56], rasclass: Supervised Raster Image Classification [57], raster: Geographic data analysis and modeling [58], rasterVis: Visualization methods for the raster package [59], rgdal: Bindings for the Geospatial Data Abstraction Library [60], RSAGA: SAGA Geoprocessing and Terrain Analysis in R [61], rworldmap: Mapping global data, vector and raster [62], divagis: tools for quality checks of georeferenced plant species accessions [63], GEOmap: Topographic and Geologic Mapping [64], trip: Spatial analysis of animal track data [65], PBSmapping: Mapping Fisheries Data and Spatial Analysis Tools [66].
IV. Packages in petrology
soilDB: A collection of functions for reading data from USDA-NCSS soil databases [67], SoilR: functions for modeling Soil Organic Matter decomposition in terrestrial ecosystems [68], soiltexture: Functions for soil texture plot, classification and transformation [69], aqp: A collection of algorithms related to modeling of soil resources, soil classification, soil profile aggregation, and visualization [70], Soilwater: Implements parametric formulas for soil water retention or conductivity curve [71].
Aspace: A collection of functions for estimating centrographic statistics and computational geometries for spatial point patterns [72], deseasonalize: Deseasonalize daily or monthly time series [73].
V. Packages in Bayesian and spatial statistic
agricolae: Statistical Procedures for Agricultural Research [74], fields: Fields is for curve, surface and function fitting with an emphasis on splines, spatial data and spatial statistics [75], sp: A package that provides classes and methods for spatial data [76], spatgraphs: Graphs, graph visualization and graph component calculations, ment to be used as a tool in spatial point pattern analysis [77], spatial: Functions for

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kriging and point pattern analysis [78], SpatialPack: Functions for kriging and point pattern analysis [79], SpatialTools: ools for spatial data analysis. Emphasis on kriging. Provides functions for prediction and simulation. Intended to be relatively straightforward, fast, and flexible [80], spatstat: Spatial Point Pattern analysis, model-fitting, simulation, tests [81], spcosa: Spatial coverage sampling and random sampling from compact geographical strata created by k-means [82], sperrorest: Spatial Error Estimation and Variable Importance [83], StatDA: Statistical Analysis for Environmental Data [84], Ares: Generates an allelic richness accumulation curve [85], geoR: Geostatistical analysis including traditional,likelihood-based and Bayesian methods [86], geospt: Spatial geostatistics; some geostatistical and radial basis functions, prediction and cross validation [87], GeoXp: Interactive exploratory spatial data analysis [88], gstat: spatial and spatio-temporal geostatisticalmodelling, prediction and simulation [89], Ngspatial: tools for analyzing spatial data, especially non-Gaussian areal data [90], psgp: Implements projected sparse Gaussian process kriging for the intamap package [91], LaplacesDemon: for Bayesian inference [92], CARBayes: Bayesian hierarchical spatial areal unit models [93]

V. CONCLUSION

As mentioned, some related packages are existed in R and using them, every expert can do most interested projects. Useful packages, books, webs and blogs introduced here than can help experts to find their needs better. Using R, nearly or perhaps all stages of projects will be done. If interested packages do not cover all users' demands, using scripts and some codes, would not be any doubt.

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