R-ArcGIS Bridge

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EDC FORUM BIG DATA ANALYTICS IN GEOGRAPHIC INFORMATION SYSTEMS
Course content

Morning (9:00-13:00):

• Introduction to R and the R-ArcGIS bridge
• Tutorial 1: Installing the R-ArcGIS bridge
• Tutorial 2: Accessing a Geodatabase from R
• Tutorial 3: One-way ANOVA: Building an R Script Tool
• Tutorial 4: Geostatistics and Point Pattern Analysis
• Tutorial 5: Extending the geostatistical capabilities of ArcGIS via the R-ArcGIS-bridge with R, Shiny and gstat
Course content

Afternoon (14:00-17:00):

• Hands-on Tutorial 1: Crime Analysis
• Hands-on Tutorial 2: Build your own shiny extension for ArcGIS
Introduction to R

- Programming language with thousands of functions organized in "packages"
- Developed from S
- Powerful language for statistics and graphics
- Packages are loaded from CRAN-Servers (Comprehensive R Archive Network)
Why R?

- It is THE standard language for statistics
- Most state-of-the-art methods are implemented in „packages“
- R is one of the fastest growing languages (11389 packages on CRAN @ 17-09-07, ~200 new/month)
- Very active community and online learning sites
- Very good graphics tools (ggplot, ggvis...)
Power of R data visualization

2014 World Cup Squads
Leagues to National Teams
by Guy J. Abel

How to Read the Plot:
- Colours based on the affiliation of each team in the FIFA World Cup.
- Lines represent the connections between the country in which players play their club football (at the time) and their national teams. The thicker the line, the more players.

140 CHARACTERS
Visualizing connections and relative tweet count from Twitter's first 140 employees
Ordered left to right by account creation date
Built with Processing, by estimae

Further details see: http://gjabel.wordpress.com
R spatial?

• CRAN Task View: Analysis of Spatial Data (180+ packages)
• CRAN Task View: Handling and Analyzing Spatio-Temporal Data (60+ packages)
• Many more recent/lively developments on r-forge, github, bitbucket, ...
• Packages for data handling (sp/sf, spacetime, gdal, ...) 
• Packages for data analysis of fields, point patterns, lattices, ...
• Lively mainling list R-sig-Geo
ArcGIS is Evolving

Web GIS

Expanding Your Capabilities

- Client / Server
- Stand-Alone Desktop
- Data Models
- Static Data
- Single Server
- Custom Applications
- Proprietary Data
- 2D Features
- Spatial Analysis
- Digital Cartography
- Web Services & Apps
- Connected Desktop
- Web Maps & Layers
- Real-Time
- Distributed Computing
- Configurable Templates & Apps
- Open Data & Shared Services
- 3D Features
- Spatiotemporal & Big Data Analytics
- Smart Mapping
Why the ArcGIS Platform?

Example from science

- **System of Insight**
  - Extract Information from Imagery
  - Professional Imagery & Geospatial Analysts
  - Content: ArcGISOnline, Desktop + Server

- **System of Record**
  - Manage and process all your imagery
  - Desktop + Server

- **System of Engagement**
  - Share imagery products and information to those that need it
  - Desktop, WebAPIs, RunTime

Example from science: Using the ArcGIS Platform for content management and processing of imagery.
The „fusion of power“ – combining GIS with R

Welcome to the R – ArcGIS Community

Combine the power of ArcGIS and R to solve your spatial problems

The R – ArcGIS Community is a community driven collection of free, open source projects making it easier and faster for R users to work with ArcGIS data, and ArcGIS users to leverage the analysis capabilities of R.

Need the R Statistical Software? Download it now.
What is the R-ArcGIS bridge?

- Allows R users to access their organization’s GIS data
- Create custom geoprocessing tools that are powered by R scripts
- Download from: https://github.com/R-ArcGIS/r-bridge-install
- Run the „Install R Bindings“ script in ArcGIS Pro
- **Requirements:** ArcGIS and R installation; RStudio recommended
  (R for 32-Bit for ArcMap (10.3.1 or later, 64-Bit for ArcGIS Pro 1.1 or later)
The `arcgisbinding` package

https://r-arcgis.github.io/assets/arcgisbinding.pdf

- R can access the Geodatabase using the `arcgisbinding` package

arcgisbinding-Package is loaded

ArcGIS for Desktop-license check

<table>
<thead>
<tr>
<th>Use</th>
<th>Use/When</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>arc.open(path)</code></td>
<td>Loading ArcGIS datasets, tables, and layers into an R workspace.</td>
</tr>
<tr>
<td><code>arc.select(object, fields, where_clause, selected, spatial_reference)</code></td>
<td>Loading a subset of the dataset into an R data frame based on specified fields and where_clause.</td>
</tr>
<tr>
<td><code>arc.shape(dataframe)</code></td>
<td>The shape object is required for analysis.</td>
</tr>
<tr>
<td><code>arc.shape2sp(dataframe)</code></td>
<td>Converting from an arcshape_class to an sp object.</td>
</tr>
<tr>
<td><code>arc.sp2data(sp dataframe)</code></td>
<td>Converting from an sp data frame object to an arc dataframe object.</td>
</tr>
<tr>
<td><code>arc.data2sp(dataframe)</code></td>
<td>Converting from an arc dataframe object to an sp data frame object.</td>
</tr>
<tr>
<td><code>arc.shapeinfo(arc.shape(dataframe))</code></td>
<td>Information about the geometries stored in the dataset is required. Type of geometry and spatial reference are some of the items returned.</td>
</tr>
<tr>
<td><code>arc.write(path, data, coords = NULL, shape_info = NULL)</code></td>
<td>Exporting a data frame object to an ArcGIS dataset.</td>
</tr>
</tbody>
</table>
R scripts can be used to build Geoprocessing tools (similar to Python scripts)

The basic components of a script tool:
- R-script
- A toolbox (ArcMap or ArcGIS Pro)
- Definition of Parameters in the script (tool_exec, in_params, out_params)
From the script to the geoprocessing tool...?
Integration within the model builder
Rise of the Andes
Tutorial 1

Installing the R-ArcGIS bridge
Installing the R-Arc-GIS bridge

1. Download the bridge on GitHub ([https://github.com/R-ArcGIS/r-bridge-install](https://github.com/R-ArcGIS/r-bridge-install))
2. Extract the zipped file on your computer
3. If necessary, download R 3.1.0 or later. Then, download RStudio Desktop. Accept all defaults in the installation wizards.
4. Open ArcGIS Pro as Administrator
5. Add the R-ArcGIS bridge toolbox to the project and run the “Install R bindings” script
Tutorial 2

Accessing a geodatabase from R
Accessing a geodatabase from R

**Script:** /ANOVA and Model-based clustering/ R/ integrating-r-with-arcgis.R

Set workspace before going through the script!
Tutorial 3

One-way ANOVA: Building a script tool
(credits to Esri Canada)
ANOVA Analysis

Definition:
The one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups.

Tutorial 4

Geostatistics and Point Pattern Analysis

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Experimenting with the R-ArcGIS bridge

May 19, 2016 • Edzer Pebesma

Around a year ago, ESRI, market leader in commercial geographic information systems, announced the R-ArcGIS bridge, a software development meant to (quote) "combine the power of ArcGIS and R to solve your spatial problems."

A MSc student in my group, Shankarlingam Sundaresan, worked for five months on a student assistant contract (10 hrs/wk) to develop some simple spatial statistical applications that could demonstrate the use of this bridge, and the possibilities and challenges of integrating functionality from some R packages in ArcGIS. We focused on package gstat for geostatistics, and package spatstat for point pattern analysis.
Tutorial 5

Extending the geostatistical capabilities of ArcGIS via the R-ArcGIS-bridge with R, Shiny and gstat
Shiny UI extension

• Shiny is a framework initially meant to share analysis and results interactively on the web

• Can also be run on a local machine within an R session, i.e. from a Script-call using the R-arcgis-bridge

• Scenario: use (full) power of gstat for variogram estimation and interpolation via an UI from inside Arc GIS

Scripts: /R-ArcGIS-bridge_Shiny
Lunch time!
Hands-on Tutorial 1

Space-time-patterns in crime
(credits to Esri US)
Hands-on Tutorial 2

Build your own shiny extension for ArcGIS
Additional information and links

Bridge & R

- Webinar R-ArcGIS bridge
- GeoNet Group R-ArcGIS
- Project homepage: https://cran.r-project.org/
  RStudio: https://www.rstudio.com/
  Homepage Hadley Wickham: http://hadley.nz/
- Statistical learning: https://lagunita.stanford.edu/courses/HumanitiesSciences/StatLearning/Winter2016/about
Thank you for your attention!