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Applied Spatial Analysis and Policy

Book Review: Advanced Spatial Data Analysis with R Roger Bivand, Edzer Pebesma and Virgilio Gomez-Rubio, Second Edition, Springer, Softcover and eBook, 405 pages, 2013

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Abstract:	<p>As a geographer and heavy R user, I was naturally excited to discover Applied Spatial Data Analysis with R (ASDAR). I purchased a copy of the first edition in the summer of 2012 at the European Region Science Association (ERSA) annual conference in Bratislava and was pleased to get my copy signed by the book's lead author and influential R programmer Roger Bivand (who also manages R's spatial 'Task View' and contributes to many R packages).</p> <p>Two years later, I no longer feel like a beginner in the world of R for geographical applications and ASDAR was certainly of great assistance. Now in its second edition, the book has been substantially rewritten to account for rapid progress in R's spatial capabilities. As an advanced user who teaches R for GIS applications and having read both versions of the book, I feel that I am well-placed to review this book.</p>

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3 **Book Review: *Advanced Spatial Data Analysis with R* Roger**
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16 As a geographer and heavy R user, I was naturally excited to discover *Applied Spatial Data*
17 *Analysis with R* (ASDAR). I purchased a copy of the first edition in the summer of 2012 at the
18 European Region Science Association (ERSA) annual conference in Bratislava and was pleased
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24 Two years later, I no longer feel like a beginner in the world of R for geographical applications
25 and ASDAR was certainly of great assistance. Now in its second edition, the book has been
26 substantially rewritten to account for rapid progress in R's spatial capabilities. As an advanced
27 user who teaches R for GIS applications and having read both versions of the book, I feel that I
28 am well–placed to review this book.
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33 The book's tone and technical focus (it contains code, equations or images on most pages) suits
34 well its intended audience: advanced or intermediate users of R wanting to improve their spatial
35 analysis skills.
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39 A major selling point of ASDAR is that its authors are some of the core developers of R's spatial
40 capabilities. This shows in the introductory chapter where R's advantages over 'legacy' GIS
41 packages are expounded: R is completely free and open source, providing huge potential
42 benefits in terms of education and reproducibility (Ince et al., 2011). Rich in code and
43 examples, the book demonstrates that R can be used as a powerful command–line GIS. Using
44 many images and case studies, ASDAR acts as a bridge between developers and users,
45 providing flesh around the terse skeleton of R's inbuilt documentation. The authors have spent
46 more time than most thinking about how best to perform spatial operations in R and this shows:
47 often there are multiple solutions to spatial problems and ASDAR provides much–needed
48 guidance on current best practice.
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54 A good example is spatial subsetting: I discovered through reading ASDAR that the elements of
55 overlap between two spatial object (a and b, say) can be found using the notation `a[b,]`. This
56 incredibly terse syntax allows complex spatial operations to be conducted with a minimum of
57 typing. This and other features make R the most intuitive and feature rich command–line GIS
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1 system available and the book does a good job of communicating this. The provision of extra
2 code and data on the ASDAR website (<http://www.asdar-book.org/>) is exemplary, allowing
3 readers to re-create most of the images on their own computers.
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5 In terms of content, ASDAR is divided into two parts: handling spatial data and analysing
6 spatial data. The former is about general purpose GIS applications that one could expect from
7 any GIS package: reprojection, overlays, visualisations, buffers, clipping and loading and saving
8 from various data formats. The final chapter on spatio-temporal data provides an excellent
9 introduction to the excellent **spacetime** package. It would be possible to harvest all this
10 information from the wider internet. But ASDAR provides the only resource, to my knowledge,
11 where it is all available in a single cohesive place with clear explanations and example data.
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14 The second part is where the power of R's spatial statistical tools become apparent. Topics
15 include point pattern analysis, geostatistics, modelling areal data (of great interest to social
16 scientists) and disease mapping. It becomes apparent that in some cases, R is the *only* high
17 level language for some operations, including customisable geographically weighted regression
18 and Bayesian modelling. Despite the provision of dozens of lines of code in each section, the
19 authors maintain an impressive adherence to the theory on which each function is based.
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22 Despite being a relatively advanced user, I have still not absorbed all the contents of ASDAR.
23 Roughly speaking I have read the book in three phases:
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- 26 1. As a beginner with R's spatial packages (but having had some experience of non-spatial
27 statistics in R).
- 28 2. As an intermediate user, trying to make maps and perform spatial analyses needed to
29 complete my thesis.
- 30 3. As an 'advanced' user, looking to communicate best practice for teaching and to
31 understand R's cutting edge geospatial capabilities.
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41 It is safe to assume that most people thinking of buying ASDAR will fit into one of these
42 categories, so let's consider each perspective.
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45 For beginners, the technical focus may be daunting: one does not need to *understand* the
46 structure of spatial data in R in order to create plots or undertake analyses. For beginners,
47 Lovelace and Cheshire (2014) may provide a more appropriate introduction to spatial data
48 analysis in R.
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51 ASDAR is more suitable for intermediate and advanced users. In some cases, you need to *get*
52 *under the hood* of the R engine to unleash its full potential and in this area the book excels.
53 Even if one is fully acquainted with one or two spatial R packages, it is almost impossible to
54 have a deep understanding of them all as there are so many. Thus ASDAR provides a much
55 needed resource for existing users who want to use the advanced functionality that the various
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add-on packages have to offer, as well as a deeper understanding of the fundamentals of spatial data handling in R.

The only downsides of the book apply to specific users:

- complete R novices will find the learning curve steep and scary (so should consult more introductory texts before reading ASDAR); and
- specialists in niches other than spatial epidemiology (e.g. LiDAR, interactive data visualisation and 3D modelling) may not find what they need.

The former point can in fact be seen as an advantage of ASDAR over other texts; it refuses to water-down key concepts and dives straight into the code at an early stage. The second point can also be seen as an advantage; it would be impossible to cover every aspect of spatial data analysis, and the authors have made a strategic decision to focus on a use case where R clearly outperforms competitors. The focus on disease mapping in Part 2 plays to R's strengths. Personally, I think the book would benefit from description of animated and online maps using the **animation**, **shiny** or **rMaps** packages. However, these are minor gripes considering the packages were not even released when the book was being written! The R spatial ecosystem is rapidly evolving so no book can be 100% up-to-date.

In summary, this book is *the* authoritative resource on R's spatial capabilities. I heartily recommend ASDAR to all existing R users interested in spatial data and adventurous R beginners with a strong grounding in GIS.

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