More Than Just Associations: An Introduction to Causal Inference for Sport Science

Master thesis

From

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Affirmation in lieu of an oath

Herewith I affirm in lieu of an oath that I have authored this Bachelor thesis independently and did not use any other sources and tools than indicated. All citations, either direct quotations or passages which were reproduced verbatim or nearby-verbatim from publications, are indicated and the respective references are named. The same is true for tables and figures. I did not submit this piece of work in the same or similar way or in extracts in another assignment.

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Personally signed

Abstract

Zusammenfassung (German Abstract)

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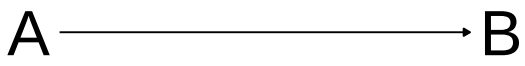

Figure 1: A simple dag

2.2 Modeling Causal Systems

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3 Methods

I conducted all analyses in this thesis using R version 4.3.1 (1) in the RStudio IDE version 2023.09.1.494 (2). The thesis was written in Quarto version 1.3.450 (3). The default settings and attached packages are documented in Appendix Section A.3. The DAGs in this thesis were drawn using the ggdag R package (4), which is based on the software daggity (5). All source code of this project is available at GitHub.

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References

1. R Core Team. *R: A language and environment for statistical computing*. Vienna, Austria: 2023. Available from: https://www.R-project.org/.
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5. Textor J, Zander B van der, Gilthorpe MS, Liśkiewicz M, Ellison GT. Robust causal inference using directed acyclic graphs: The r package 'dagitty'. *International Journal of Epidemiology*. 2016;45(6):1887–94.

A Appendix

A.1 Mathematical Background

A.2 Simulations

A.3 Technical Details

A.3.1 Session Info

```
sessionInfo()
```

```
R version 4.3.1 (2023-06-16 ucrt)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows 11 x64 (build 22631)

Matrix products: default


locale:
[1] LC_COLLATE=German_Germany.utf8  LC_CTYPE=German_Germany.utf8
[3] LC_MONETARY=German_Germany.utf8 LC_NUMERIC=C
[5] LC_TIME=German_Germany.utf8

time zone: Europe/Berlin
tzcode source: internal

attached base packages:
[1] stats     graphics  grDevices utils     datasets  methods   base

other attached packages:
[1] ggplot2_3.5.0 ggdag_0.2.12  dagitty_0.3-4

loaded via a namespace (and not attached):
 [1] viridis_0.6.5      utf8_1.2.4         generics_0.1.3     tidyr_1.3.1
 [5] stringi_1.8.3      digest_0.6.35      magrittr_2.0.3     evaluate_0.23
 [9] grid_4.3.1         fastmap_1.1.1      rprojroot_2.0.4    jsonlite_1.8.8
[13] ggrepel_0.9.5      gridExtra_2.3      purrr_1.0.2        fansi_1.0.6
[17] viridisLite_0.4.2  scales_1.3.0       tweenr_2.0.3       cli_3.6.2
[21] rlang_1.1.3        graphlayouts_1.1.1 polyclip_1.10-6    tidygraph_1.3.1
[25] munsell_0.5.0      withr_3.0.0        cachem_1.0.8       yaml_2.3.8
[29] tools_4.3.1        memoise_2.0.1      dplyr_1.1.4        colorspace_2.1-0
[33] here_1.0.1         boot_1.3-28.1      curl_5.2.1         vctrs_0.6.5
[37] R6_2.5.1           lifecycle_1.0.4    stringr_1.5.1      V8_4.4.2
[41] MASS_7.3-60        ggraph_2.2.1       pkgconfig_2.0.3    pillar_1.9.0
[45] gtable_0.3.4       glue_1.7.0         Rcpp_1.0.12        ggforce_0.4.2
[49] xfun_0.43          tibble_3.2.1       tidyselect_1.2.1   rstudioapi_0.16.0
```

```
[53] knitr_1.45          farver_2.1.1        htmltools_0.5.8     igraph_2.0.3
[57] labeling_0.4.3      rmarkdown_2.26      compiler_4.3.1
```

A.3.2 Packages

```
p_used <- unique(renv::dependencies(path = "../")$Package)
```

```
Finding R package dependencies ... Done!
```

```
p_inst <- as.data.frame(installed.packages())
out <- p_inst[p_inst$Package %in% p_used, c("Package", "Version")]
rownames(out) <- NULL
out
```

```
    Package Version
1   dagitty   0.3-4
2     ggdag  0.2.12
3   ggplot2   3.5.0
4      here   1.0.1
5      renv   1.0.5
6 rmarkdown    2.26
```