Luis E. Carvalho

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Boston University
Dept. of Mathematics and Statistics
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Boston, MA 02215

CURRICULUM VITAE

Education

Brown University
Division of Applied Math
Providence, RI

Ph.D., 2003–2008
Title: Bayesian centroid estimation
Advisor: Charles Lawrence, PhD
Related areas: Computational biology, Bayesian statistics, Statistical inference.

**Federal University
of Ceara** (UFC)
Dept. of Computer Science
Brazil

M.Sc., 2000–2002
Title: Bounded tree width decomposition in graphs: an algorithmic research
Advisor: Claudia Linhares-Sales, PhD
Related areas: Graph theory, Combinatorial optimization, Algorithm analysis and complexity.

**Federal University
of Rio de Janeiro** (UFRJ)
Program in Transportation
Engineering (PET)
Brazil

M.Sc., 1998–2001
Title: Development of an integrated solution for solid waste collection systems in GIS (Geographic Information System) environment
Advisor: Amaranto Pereira, PhD
Related areas: Logistics and optimization, Information systems, Urban development.

**Federal University
of Ceara** (UFC)

B.S., 1993–1997
Civil Engineering, *Magna Cum Laude*

Research Interests

Bayesian Statistics

Statistical inference (point and interval estimation) on high-dimensional discrete spaces: characterization, algorithms, and applications. Centroid estimation.

Computational Statistics

MCMC methods in discrete structures and constrained high-dimensional discrete spaces. Graphical models.

Computational Biology

Bayesian statistical inference applied to sequence analysis, RNA secondary structure prediction and classification, phylogenetic analysis, genome-wide association studies (GWAS), motif discovery, and, more generally, systems biology.

Networks

Community detection and inference in stochastic block models.

Remote sensing

Land cover classification using MODIS data, biomass assessment using MODIS and GLAS data.

Research Interests (continued)

Transportation Engineering   Origin-destination matrix estimation, link count based inference, traffic assignment.

Professional Experience

Fall 2009–   **Assistant Professor**, Dept. of Math. and Statistics, Boston University

Fall 2008–Spring 2009   **Postdoctoral Researcher**, Division of Applied Math., Brown University

2001–2002   **Consultant** on Logistics and Geographic Information Systems (GIS), Brazil

1997–1999   **Project Manager**, Construtora Marquise, Brazil

Teaching Experience

Spring 2013   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Basic Statistics and Probability $\sim$ 130 students
Generalized Linear Models $\sim$ 15 students

Fall 2012   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Computational Statistics $\sim$ 30 students

Spring 2012   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Basic Statistics and Probability $\sim$ 130 students

Fall 2011   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Linear Models $\sim$ 60 students

Summer 2011   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Basic Statistics and Probability $\sim$ 30 students

Spring 2011   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Basic Statistics and Probability $\sim$ 125 students

Fall 2010   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Linear Models $\sim$ 40 students
Bayesian Statistical Modeling and Discrete Inference $\sim$ 20 students

Spring 2010   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Basic Statistics and Probability $\sim$ 125 students

Fall 2009   **Assistant Professor**, Dept. of Math. and Statistics, Boston University
Linear Models $\sim$ 50 students

Spring 2009   **Postdoctoral Researcher**, Division of Applied Math, Brown University
Computational Statistics $\sim$ 20 students

2004, 2006   **Teaching Assistant**, Division of Applied Math, Brown University

Teaching Experience (continued)

Fall 2006: *Methods of Applied Mathematics I* (advanced) ~ 60 students
Spring 2006: *Essential Statistics* ~ 100 students
Spring 2004: *Methods of Applied Mathematics I* ~ 50 students
Provided recitation sessions, individual tutoring, and homework grading.

Fall 2003   **Computer Assistant**, Division of Applied Math, Brown University
Tutored users regarding Matlab, S-Plus and general programming and algorithms.
Taught short courses on these languages.

Selected Publications and Presentations

- Carvalho, L. E., (2013) *A Bayesian Statistical Approach for Inference on Static Origin-Destination Matrices in Transportation Studies*. Technometrics, `doi:10.1080/00401706.2013.826144`

- Carvalho, L. E., (2013) *Bayesian Centroid Estimation for De Novo Motif Discovery*. PLoS ONE, 8(12): e80511. `doi:10.1371/journal.pone.0080511`.

- Johnston, I. and Carvalho, L. E., (2013) *A Bayesian Hierarchical Gene Model on Latent Genotypes for Genome-Wide Association Studies*. BMC Proceedings, *In press, 2013.*

- Carvalho, L. E. and Loureiro, C. F. G., (2010) *A Bayesian multinomial-Poisson simplified model for network traffic inference based on link cound data*. In: World Conference in Transport Research, 2010, Lisbon, Portugal.

- Carvalho, L. E. and Lawrence, C. E., (2008) *Centroid estimation in discrete high-dimensional spaces with applications in biology*. Proc. Nat. Acad. Sci. USA 105(9):3209–3214.

- McKee, A. E., Neretti, N., Carvalho, L. E., Meyer, C. M., Fox, E. A., Brodsky, A. S., and Silver, P. A., (2007) *Exon expression profiling reveals stimulus-mediated exon use in neural cells*. Genomy Biology 8:R159.

- Carvalho, L. E., Building data structures and iterators in Lua, In: de Figueiredo, L. H., Ierusalimschy, R., and Celes, W. (eds.), *Lua programming gems*, Lua.org.

- Carvalho, L. E., A primer of scientific computing in Lua, In: de Figueiredo, L. H., Ierusalimschy, R., and Celes, W. (eds.), *Lua programming gems*, Lua.org.

- Vieira, A. B., Carvalho, L. E., Balassiano, R., Teypaz, N., and Cung, V., (2007) Solving the transit network design problem with constraint programming. In: *11th World Conference on Transport Research (WCTR)*, Berkeley, CA.

- Carvalho, L. E., Silva, H. N., Loureiro, C. F. G., and Meneses, H. B., (2006) Geographically weighted linear regression in GIS environment (in portuguese). In: *XX Congresso de Pesquisa e Ensino em Transportes – ANPET*, Brasilia, DF, Brazil.

- Loureiro, C. F. G., Silva, H. N., and Carvalho, L. E., (2006) Analysis methodology for geographically weighted linear regression when applied to intermunicipal trip phenomena (in portuguese). In: *XX Congresso de Pesquisa e Ensino em Transportes – ANPET*, Brasilia, DF, Brazil.

Submitted or In-preparation Publications

- Carvalho, L. E., *An Improved Evaluation of Kolmogorov's Distribution*. Submitted.

- Glanz, H. and Carvalho, L. E., Sulla-Menashe, D., and Friedl, M., *Land Cover Classification in Multitemporal MODIS Data Using Principal Component Analysis*. Submitted.

- Glanz, H. and Carvalho, L. E., *An Expectation-Maximization Algorithm for the Matrix Normal Distribution*. Submitted.

- Peng, L. and Carvalho, L. E., *Bayesian Degree-corrected Stochastic Block Models for Community Detection*. Submitted.

- Johnston, I., Hancock, T., Mamitsuka, H., and Carvalho, L. E., *Hierarchical Gene-Proximity Models for Genome-Wide Association Studies*. Submitted.

- Pham, L. M., Carvalho, L. E., Schaus, S., and Kolaczyk, E. D., *Perturbation Detection Through Modeling of Gene Expression on a Latent Biological Pathway Network: A Bayesian Hierarchical Approach*. Submitted.

- Gomes, A. L. C., Abeel, T., Peterson, M., Azizi, E., Lyubetskaya, A., Carvalho, L., and Galagan, J. *Decoding ChIP-seq with a Double-Binding Signal Provides Site Detection with Single-Nucleotide Resolution and Predictions of Cooperative Interaction*. Submitted.

- Carvalho, L. E. and Lawrence, C. E., *Constraint Graphs and Graph Centroid Estimation*. In preparation.

- Glanz, H. and Carvalho, L. E., *A Spanning Tree Hierarchical Model for Land Cover Classification*. In preparation.

Invited Talks

December 2013   *A Hierarchical Statistical Model and Computational Methods for Genome-Wide Association Studies*, Forsyth Institute, Cambridge, MA.

October 2013   *Inference in Discrete Multidimensional Spaces: A Bayesian Approach*, First Symposium of the Brazilian Scientific Community in New England, Cambridge, MA.

September 2013   *Bayesian Centroid Estimation for Discrete Inference: Theory and Applications*, Boston-Keio Summer Workshop, Boston, MA.

April 2013   *Graph-regularized Centroid Estimation on a Hierarchical Bayesian Model for Genome-Wide Association Studies*, 27th New England Statistics Symposium, Storrs, CT.

December 2012   *Graph-regularized Centroid Estimation on a Hierarchical Bayesian Model for Genome-Wide Association Studies*, Bayesian Methods in Biostatistics and Bioinformatics, Barcelona, Spain. Jointly with Ian Johnston.

November 2012   *Integrating Lua for Fun and Profit: Vim's `if_lua` and PostgreSQL's PL/Lua*, Lua Workshop 2012, Reston, VA.

Invited Talks (continued)

June 2012   *Bayesian Centroid Estimation for Genome-Wide Association Studies*, SIAM Conference on Discrete Mathematics, Halifax, Canada.

April 2012   *Bayesian Centroid Estimation for Motif Discovery*, 26th New England Statistics Symposium, Boston, MA.

April 2012   *MODIS Land Cover Classication using Mutual Information Spanning Trees*, 26th New England Statistics Symposium, Boston, MA. Jointly with Hunter Glanz.

April 2012   *A Gene-SNP Hierarchical Bayesian Model for Genome-Wide Association Studies*, 26th New England Statistics Symposium, Boston, MA. Jointly with Ian Johnston.

April 2012   *Bayesian Degree-corrected Stochastic Block Models for Community Detection*, 26th New England Statistics Symposium, Boston, MA. Jointly with Lijun Peng.

March 2012   *A Hierarchical Gene-SNP Bayesian Model for Genome-Wide Association Studies*, Biostatistics Seminar, Boston University.

May 2011   *Doing Bioinformatics in PostgreSQL*, PGCon 2011, Ottawa, Canada.

April 2011   *Bayesian Land Cover Classification for MODIS Data*, 25th New England Statistics Symposium, Storrs, CT.

October 2010   *Bayesian Inference for Genome-Wide Association Studies*, Biostatistics Seminar, Boston University.

June 2010   *Bayesian Inference for Genome-Wide Association Studies*, The 19th Annual ICSA Applied Statistics Symposium, Indianapolis, IN.

April 2010   *Bayesian Inference for Genome-Wide Association Studies*, Statistics and Probability Seminar, Boston University.

April 2010   *Bayesian Centroid Estimation*, The 24th New England Statistics Symposium, Cambridge, MA.

February 2010   *Applications of Centroid Estimation to Statistical Genetics*, Statistical Genetics Seminar, Dept of Biostatistics, Boston University.

Contributed Talks, Abstracts, and Posters

August 2013   *Reducing Dimensionality in Multitemporal MODIS Data Using Principal Component Analysis for Land Cover Mapping*, Joint Statistical Meetings 2013, Montreal, Canada. Jointly with Hunter Glanz, Damien Sulla-Menashe, and Mark Friedl.

August 2013   *Detecting Perturbed Biological Pathways Through Latent Network Modeling of Gene Expression*, Joint Statistical Meetings 2013, Montreal, Canada. Jointly with Eric Kolaczyk, Lisa Pham, and Scott Schaus.

August 2013   *Bayesian Centroid Inference and Characterization of Posterior Spaces with Applications in Motif Finding*, Joint Statistical Meetings 2013, Montreal, Canada.

Contributed Talks, Abstracts, and Posters (continued)

August 2012   *Approximate Centroid Inference for Complex Graphical Models*, Joint Statistical Meetings 2012, San Diego, CA. Jointly with <u>Hunter Glanz</u>.

August 2012   *Perturbation Detection through Modeling of Gene Expression on a Latent Biological Pathway Network*, Joint Statistical Meetings 2012, San Diego, CA. Jointly with <u>Lisa Pham</u>, Scott Schaus, and Eric Kolaczyk.

August 2012   *A Bayesian Degree-Corrected Stochastic Block Model for Community Detection*, Joint Statistical Meetings 2012, San Diego, CA. Jointly with Lijun Peng.

July 2012   *Bayesian Centroid Estimation for De-novo Motif Discovery*, 8th World Congress in Probability and Statistics, Istanbul, Turkey.

June 2012   *Graph-regularized Centroid Estimation on a Hierarchical Bayesian Model for Genome-Wide Association Studies*, 11th ISBA World Meeting, Kyoto, Japan. Jointly with <u>Ian Johnston</u>.

December 2011   *Uncertainty Analysis in Large Area Aboveground Biomass Mapping*, AGU Fall Meeting 2011, San Francisco, CA. Jointly with <u>Alessandro Baccini</u>, Ralph Dubayah, Scott Goetz, and Mark Friedl.

July 2011   *Bayesian Land Cover Classification for MODIS Data*, Joint Statistical Meetings 2011, Miami Beach, FL

October 2010   *Bayesian Centroid Inference for Genome-Wide Association Studies*, The 19th Annual IGES Meeting, Boston, MA

October 2010   *Bayesian Centroid Inference for Genome-Wide Association Studies*, Annual Genome Science Institute Research Symposium, Boston University Medical Center, Boston, MA.

July 2010   *Bayesian Centroid Estimation*, The 13th Annual IMS Meeting of New Researchers in Statistics and Probability, Vancouver, Canada

Professional Activities

2010–   Ad-hoc *reviewer* for *Bayesian Analysis*, *Technometrics*, *Statistics and Computing*, *Remote Sensing of Environment*, *BMC Bioinformatics*.

2009–2012   Boston University Statistics and Probability Seminar *organizer*.

2009–   Boston University Department of Mathematics and Statistics: *member* of computer committee, web page committee, and graduate student committee.

Professional Memberships

2011–   Institute of Mathematical Statistics

Professional Memberships (continued)

2011–   International Society of Bayesian Analysis

2010–   International Genetic Epidemiology Society

2010–   American Statistical Association

2008–2009   International Society for Computational Biology

2002–2009   American Mathematical Society

Honors and Awards

2011-   National Science Foundation grant DMS-1107067, *High-dimensional Discrete Inference*, Principal Investigator.

2011-   Boston University RULE grant to redesign the basic statistics courses.

2002–2008   Brown University fellowship (2002), Teaching Assistant scholarship (2003, 2005), Research Assistant scholarship (2004, 2006–2008).

2000–2002   FUNCAP (Brazilian agency for research support) scholarship for research support during M.Sc. in Computer Science.

1999   CAPES (Brazilian funding agency for individual development through science) scholarship for research support during M.Sc. in Transportation Engineering.

1997   *Best National Engineering Student*, according to a nationwide test (*Provao*, Brazil).

1994–1997   CAPES scholarship for best (top 1%) undergraduate students.