

Dr David Maybury
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To whom it may concern,

I am the lead data scientist and founder of Public Service and Procurement Canada's (PSPC) data science team. In December of 2017, I moved to PSPC to build and lead its data science initiative after a decade as a senior operational research scientist with Defence Research and Development Canada. I provide the technical leadership and oversight of the team, including the supervision of all statistical approaches, code quality, and accuracy of results. My team provides data science solutions to PSPC branches and occasionally to other departments in the Government of Canada. We provide complete solutions, from the mathematical modelling—including deep learning and artificial intelligence—to data visualization through custom web apps hosted on our servers. We maintain our project code, mostly composed of our custom built R packages, on our internal GitLab server.

Our insights help senior decision makers understand the consequences of different courses of action by allowing them to create counterfactual scenarios. My mathematical and statistical approach for the team sits squarely in two worlds: operational research dovetailed with data science. Since our modelling efforts use this multidisciplinary approach, we provide decision makers with an interpretable structure that makes economic comparisons transparent.

I have grown our team to five members, hosting specializations in data visualization through web based applications, stochastic process modelling, and optimization. Survival/multi-state analysis in the presence of competing risks, and multilevel/hierarchical regression are two themes that particularly stand out in our recent client work. We use modern methods, implementing multilevel/hierarchical methods estimated by Markov Chain Monte Carlo, Bayesian filtering, hierarchical clustering, measure theoretic probability analysis, and other machine learning methods including gradient boosted machines, random forests, deep autoencoders, and generalized additive mixed models. Some of our recent work involves external clients such as the Public Health Agency of Canada (PHAC), and Correctional Services Canada (CSC). Our efforts have led senior management to alter their approach and sharpen their decision making around on-the-ground efforts.

My team provided key data science and operational support to the government during the height of the Phoenix pay system failure—a pay system which governs compensation for over 200,000 civil servants. I designed our operational research approach to the queue using machine learning and artificial intelligence. I built the AI system for detecting pension contribution anomalies generated by Phoenix errors using deep autoencoders for non-linear matrix factorization. For estimating queueing dynamics, we relied on survival analysis, competing risks, and multilevel/hierarchical regression. We provided the official government of Canada pay case queue forecast, which was based on our time series modelling, for the Parliamentary Secretary and Cabinet. Finally, we produced a dynamic program of queue discipline switching

based on case type to improve the manual resolution of the backlog along with new intake. We created data visualizations of the queue for senior management on an internally hosted web app which wrapped around our mathematical models of the wait-time-in-system, forecasts of queue depths, and stochastic models of the arrival and completion process. The data set was composed of over 10 million pay cases, each with a rich employee attribute structure.

Currently, my team's main client is PSPC's Real Property Services. I built a combinatorial optimization solution for the Government of Canada's real estate divestment problem in light of the new hybrid work arrangements. The optimization engine creates variations of the knapsack problem using the government's building criteria, reduced office space requirements, and the commute-times of employees. Under my direction, my team created an enterprise-wide web app around the optimization. Decision makers explored and manipulated portfolio solutions across all Canadian metropolitan areas within our custom-made geospatial platform. The final real estate portfolio from our modelling went to Cabinet for making the final divestment decision.

I also have a rich background in financial engineering. While supporting the Assistant Deputy Minister of Materiel at DND, I focused on financial decision problems. My efforts included foreign exchange rate volatility smile modelling and time series analysis of DND's spending to assess financial risk during complex procurements. I implemented and calibrated stochastic volatility models to publicly traded option data which gave National Defence visibility on foreign exchange risk through monitoring smile dynamics. For a specific procurement project with multiple currency exposures, I built a copula based Value-at-Risk tool from generalized autoregressive conditional heteroskedasticity (GARCH) filtered return data. I placed significant effort into fixed income engineering and credit derivative evaluation (swaptions and credit default swaps) for modelling interest rate and inflation risk.

I have a proven track record in research excellence and scientific leadership, which includes a postdoctoral fellowship with the theoretical physics group at the University of Oxford, and the NATO operations research paper of the year (2016). In addition to my research at Oxford, I lectured graduate courses on early universe cosmology and particle physics. I have published original research in the journals of Nuclear Physics B, Physical Review D, The Journal of High Energy Physics, and The Journal of Theoretical Biology.

At heart, I am a passionate applied mathematician with a deep interest in stochastic phenomena. I am always looking for opportunities to transform data into useful decision insights.

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Enclosures: CV

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About me

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Areas of specialization

- Statistical learning/AI
 - Operations research
 - Financial engineering
- Hierarchical Modelling
- Stochastic processes
 - R and Python

Personal

Nationality: Canadian

SHORT RESUME

2018–present

Head Data Scientist

PUBLIC SERVICES AND PROCUREMENT CANADA · Artificial Intelligence and Machine Learning



- Lead a team of data scientists developing statistical models and library packages in R for decision making insight at Deputy/Assistant Deputy Minister level; mentor the team members, provide scientific leadership, and direct DevOps for production level applications.
- Spearhead major projects with the government of Canada's real estate portfolio rationalization initiative from the hybrid work policy: combinatorial optimization models (mix integer linear programming) for government real estate divestment recommendations; multivariate statistical models (conditional copulas) for building occupancy estimation from sensor data.
- Provide mathematical models of the Phoenix pay system queue, and the public service pension system: applications of survival analysis, time series modelling, support vector machines, autoencoders, multi-criteria decision analysis, queueing theory, dynamic programming, and inference with multilevel/hierarchical regression.
- Contribute to the federal government's efforts against COVID-19: original research in modelling propagation as a branching process, application of branching processes to workplace mitigation using cloud computing, original research with the Public Health Agency of Canada on the application of Bayesian hierarchical analysis of seroprevalence data, and on forecasting provincial ICU occupation using hidden Markov models and Skellam processes.
- Lead development of web-based data visualization platforms in Shiny for senior decision makers.
- Build data science solutions with external departments including Global Affairs Canada, Correctional Services Canada, and the Public Health Agency of Canada.

2008–2017

Senior Operational Research Scientist

DEFENCE RESEARCH AND DEVELOPMENT CANADA · Centre for Operational Research and Analysis



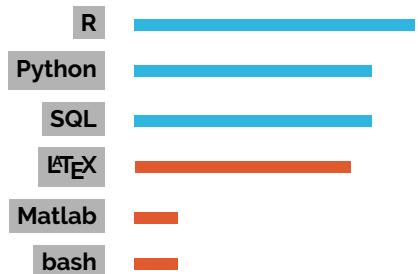
- Led the international NATO task group on military economics with a focus on real option analysis applied to fleet replacement: treated fleet replacement as an American style option (contingent claim analysis).
- Applied machine learning techniques (tree based methods, hidden Markov models, and additive models) to naval operational data for improving schedules at the fleet maintenance facilities.
- Created geospatial stochastic filtering techniques for tracking ship movements in the Arctic from incomplete and noisy observations.
- Developed and implemented foreign exchange risk models in R and MATLAB for defence procurement risk monitoring: stochastic volatility modelling, derivative pricing, model inference from traded assets, applications of stochastic calculus.
- Provided decision support and risk assessment directly to Assistant Deputy Minister/Flag officer level: inventory control, fleet performance, financial risk.

DEGREES

2005 **Physics**
PHD · University of Alberta
Thesis: *Electroweak physics beyond the standard model* 

1999 **Applied Mathematics**
BSc · Western University 

PROGRAMMING



CURRICULUM

2008–2018	Evening Lecturer CARLETON UNIVERSITY · Department of Physics  Taught two astronomy courses every year: Introduction to the solar system; Introduction to stars, galaxies, and cosmology.
2005–2007	Canada-United Kingdom Millennium Postdoctoral Fellow UNIVERSITY OF OXFORD · Rudolf Peierls Centre for Theoretical Physics  Published original research on supersymmetric models, neutrino physics, extra dimensional physics, and early universe cosmology. Lecturer in early universe cosmology for the theoretical physics postgraduate program at Oxford.

AWARDS

- 2023** PSPC Real Property Services award.
- 2020** Nominated for the Government of Canada Public Service Award.
- 2016** NATO operational research paper of the year.
- 2010** DRDC operational research paper of the year.
- 2010** Best lecturer, Faculty of Science, Carleton University.
- 2005** NSERC postdoctoral fellowship award.
- 2005** Governor General's gold medal of academic excellence.

RECENT EXTERNAL PUBLICATIONS

- 2021** Valerie Hongoh, David Maybury, Jérôme Levesque, Aamir Fazil, Ainsley Otten, Patricia Turgeon, Lisa Waddell, and Nicholas H Ogden. **Evaluating transmission risk of covid-19 at gatherings.** *CCDR*, 47:11, 2021.
- 2020** Jérôme Levesque, David W Maybury, and RHA David Shaw. **A model of covid-19 propagation based on a gamma subordinated negative binomial branching process.** *Journal of Theoretical Biology*, page 110536, 2020.
- 2020** Jérôme Levesque and David W Maybury. **A note on covid-19 seroprevalence studies: a meta-analysis using hierarchical modelling.** *MedRxiv*, 2020.

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