

- **An explanation of any relevant background you have in category theory or any of the specific projects areas**

I have no formal background in category theory, but I have been studying books, notes and blog posts about category theory ever since I discovered its existence last spring. For several years I have been researching a problem of mathematical foundations in economics, and I believe that tools in category theory offer a solution.

- **The date you completed or expect to complete your Ph.D and a one-sentence summary of its subject matter.**

Because of the unusual nature of my research—categorical foundations of economic theory—I have delayed pursuing a PhD until aspects of my thesis become more concrete. Until then it will be hard to find a program and an advisor who fit my project. However, the subject matter is as follows: using category theory to derive the foundational ideas of economics such as scarcity, self-interest, etc., and develop extensions to fill in gaps in our understanding of the economy that current economic theory is struggling to address.

- **Order of project preference**

I am particularly interested in David Spivak's work on providing a mathematical foundation for autopoiesis, as I am also trying to provide a mathematical foundation for certain phenomena in science. Beyond that, I have no particular preference.

- **To what extent can you commit to coming to Oxford (availability of funding is uncertain at this time)**

I expect to be working and might not be able to come for both weeks. However, I believe I should be able to attend for at least one week.

- **A brief statement (~300 words) on why you are interested in the ACT2019 School.**

Probably unbeknownst to most mathematicians, a growing consensus has emerged in neuroscience about the centrality of prediction to human action—to wit, human action *is* prediction. Prediction is only possible with a model, and since human beings have to predict, and therefore model, a vast array of incredibly different phenomena, from simple physics to their fellow humans, a “*universal modeling language*” is clearly required to understand human beings—i.e., you need category theory. This is the basic motivation for my idea that economics needs category theory.

I have been studying and trying to apply category theory on my own since the spring of 2018, when I discovered the existence of category theory. However, without the possibility of interaction with other people who are trying to apply category theory, it will be difficult to make significant progress. The ACT2019 School presents an incredible opportunity to advance my understanding of category theory and my ability to apply it to economics.

Beyond my personal research, I am simply fascinated by the potential for applied category theory. The challenges of unifying fundamental physics, for example, will surely be aided by category theory’s incredible power for unifying ideas. Research in AI will surely come to rely on category theory for the same reason that I believe neuroscience and economics will—an entity that can model modeling sounds very much like what AI is.

Eventually I would also like to see category theory find applications in business as well, not just science. A job or research position based around category theory is my ideal work situation, and ACT2019 would be an incredible step forward in achieving that dream.

Benjamin Lyons

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Education: B.S. in Economics, August 2018

George Mason University, Fairfax, VA

Research:

Working paper, "Using category theory to derive a starting point in economics"

- Uses category theory to develop axiomatic concepts in economics like scarcity, maximization, self-interest, etc., as theorems of a deeper mathematical system than economists have used.

Working paper, "Systematic mathematical error in economics"

- Discusses the existence and causes of predictable mathematical error in economic theorizing and solutions.

Presentations:

Southern Economic Association, "The Conceptual Knot," 2016

- Independently developed line of research into the theoretical underpinnings of modern welfare economics and presented the paper at a panel
- Served as discussant for the other papers on the same panel

Society for the Development of Austrian Economics, "How Competition Creates Economics," 2013

- Winner of the Carl Menger Undergraduate Contest for essay on the underlying forces behind economic optimization
- Presented essay at Southern Economic Association conference

Work Experience:**Barnes and Noble, Houston**

Bookseller, Currently

Cato Institute, Washington D.C.

Intern, Center for Economic Studies, Spring 2018

- Researching the causes of the opioid crisis, using three international health databases
- Collecting data on state-level tax, expenditure and state-to-state migration flows for all states
- Developing critique of Smart Approaches to Marijuana for a debate between Jeffrey Miron and Kevin Sabet

Texas Public Policy Foundation, Austin

Intern, Center for Higher Education, Fall 2017

- Researched the causes of rising college tuition using national databases and individual university budgets
- Provided research for, and edited articles and op-eds published on Forbes.com
- Wrote initial draft of white paper on the relationship between federal aid and college tuition, working title "What Do We Know About the Bennett Hypothesis?"

Interdisciplinary Affective Science Laboratory at Northeastern University, Boston

Intern, Summer 2016

- Supported analysis of emotional response and biokinetic data to yield some

of the first experimental results on psychological theories of emotion with respect to video stimuli

- Tracked thousands of experiment participant data points in Excel and coded a data parsing algorithm in Matlab



Department of Economics

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To Whom It May Concern:

Benjamin Lyons, a 2017 graduate of George Mason University with a BS in economics, has asked me to write him a letter of recommendation for the ACT2019 School. I'm delighted to do so.

While pursuing his undergraduate studies, Benjamin sought me out to discuss various ideas he had in economics. I had never met Benjamin before and never had him in a class (I teach only graduate students), so I wasn't sure what to expect. What I found was one of the most interesting minds I've ever encountered.

Benjamin's curiosity is boundless, and his ability to see to the foundation of questions (in economics, at least) is uncanny. I really couldn't believe I was talking with an undergraduate when we met, as we did quite a few times, since I so enjoyed it. I urged Benjamin—begged him, actually—to pursue his PhD in economics. For reasons I still don't understand, he demurred. It bothers me that I failed to convince him.

Sometime not long after he graduated and had moved out of the DC area, Benjamin began emailing me with messages about category theory: he wanted me to learn about it and to discuss with me its implications for economics. He told me he was convinced that category theory (which, apparently, he had been studying) was the key to reformulating economics along more productive lines. To be honest, I don't think economics needs any reformulating; I guess I'm just old fashioned in that way, and I told Benjamin as much. Still, he has not given up on convincing me, which gives me hope that I might still manage one day to convince him to get is doctorate in economics.

I recommend Benjamin to you in the highest possible terms. He is a very, very rare mind. And one way or another, his mind needs to be applied to important questions in social science. If that means learning more about category theory, I'm all for it.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Pete Leeson". The signature is stylized with a large, looped "P" and a cursive "Leeson".

Pete Leeson

Duncan Black Professor of Economics and Law