To the Admissions Committee,

It is with great enthusiasm that I hereby submit my application for the PhD Program at Stanford's Department of Statistics. I firmly believe it is Stanford that can offer me the best environment to realize my research projects and prepare for a scientific career in statistics.

I am currently pursuing a research Master's Degree in Mathematics (Statistics Concentration) at Université du Québec à Montréal (UQAM) and I did my Bachelor in Pure Mathematics at the same institution. My pre-university education emphasized **programming and project-based learning**. For instance, I learned Object-Oriented and Event-Driven Programming in Java at the time. One of my projects, featured on CEGEP Limoilou's homepage in 2014, is still up at http://olivierbinette.ca/Fractals. It exploited early Javascript multithreading technology to allow the interactive exploration of high-resolution fractal images. My personal blog at http://mathstatnotes.wordpress.com showcases my more recent interests which are now linked through statistics and applied mathematics.

My main bachelor and master research has focused on Bayesian nonparametrics and I have submitted two papers. The first outlines the use of Bayesian nonparametrics in circular and directional statistics. It addresses some criticisms about the use of truncated Fourier Series by suggesting an alternative density basis - analogous to the Bernstein polynomial densities - which facilitates the specification of informative priors on circular density spaces. This is inscribed in a framework of density estimation on compact metric spaces using sieve priors for which a general theory is provided. My second paper is a short note submitted as a correspondence to the IEEE Transactions on Information Theory. It provides optimal upper bounds on f-divergences in terms of the total variation distance and likelihood ratio extremums. Inequalities of this type are commonly used to control the prior probability of Kullback-Leibler neighbourhoods which is of significant interest in Bayesian nonparametrics. During summer 2017, I have also collaborated with Professor Debdeep Pati from Texas A&M University by helping revise the prepublication *Bayesian Closed Surface Fitting through Tensor Products*. While I was already very familiar with the contents of the paper, this provided me with early insight and perspective about scientific writing and the publishing process.

One research project that I am most excited about developing while at Stanford - some of the work of Professor Jonathan Taylor is particularly relevant in that regard - is on **topological consistency for Bayesian surface reconstruction algorithms**. To give a particular example, it is possible to frame binary classification as a problem of reconstructing the surface separating classes. Topological consistency in this case implies the consistent estimation of the number of class clusters and of other summaries. Furthermore, quantifying uncertainty about topological features raises fascinating problems which are, in this case, closely related to posterior convergence in Sobolev norms. I am collaborating with

Professor Debdeep Pati this winter on fast learning rates for plug-in classifiers using particular types of Gaussian Process priors. This will prepare me for further work on the more delicate (topological) aspects of posterior convergence.

Statistics is currently undergoing non-negligible changes and **I want to work at its forefront**. Its shift towards computational and data-driven methods, propelled by the scale and complexity of gathered data, has brought with it fascinating challenges. For instance, my interest in topological consistency also comes from the idea that it may help in the interpretation and validation of machine learning procedures: accurately uncovering topological structure, beyond only ensuring adequate predictive performance, could help provide useful output summaries.

I am also very much concerned with the misuses of statistical methods. Some users tend to project their desires into analyses, as testifies unadjusted selective inference and common misinterpretations of p-values. However, I do not only want to teach about the limitations of current techniques; I want to **develop more powerful and complete inferential frameworks** using cutting-edge mathematics. Building bridges with different subfields of Mathematics appears to be a hallmark of research at Stanford and has provided breakthroughs in the past. My formal mathematical education, which focused on the two axes of geometry/analysis and algebra/combinatorics, has provided me with the necessary breadth and experience to build on these links and apply them to modern statistical problems.

I would love Stanford to be the institution where I take my next big step forward. This would enable me to consolidate my abilities as a statistician, advance my research under the supervision of world-leading scholars in the field and eventually grow into a leader myself.

Sincerely,

Olivier Binette