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## STAFF MATTERS

### Department delivers first joint PhDs

By: Daniel Bugan

The Department of Statistics and Actuarial Science at Stellenbosch University (SU) recently delivered its first ever joint doctorates with two Belgian universities: Ghent University and the Catholic University of Leuven (KU Leuven). The joint PhDs were awarded to Dr Carel van der Merwe, senior lecturer in Financial Risk Management in the Department, and Dr Sven Buitendag of Capitec Bank.

This brings to four the number of joint PhDs delivered by the Faculty of Economic and Management Sciences. A joint doctoral degree is made possible through a contract of cooperation between the doctoral researcher, the PhD supervisors (at least one at each institution) and the respective institutions.

Van der Merwe received his joint doctorate in Mathematical Statistics at SU and in Economics at Ghent University. His supervisors were Prof Tertius de Wet (SU), as well as Professors Koen Inghelbrecht and co-supervisor Michèle Vanmaele of Ghent University.

"As part of the joint PhD you are required to spend at least six months at the partner university. I enjoyed spending time at an international university and working with other PhD students at Ghent," he said.

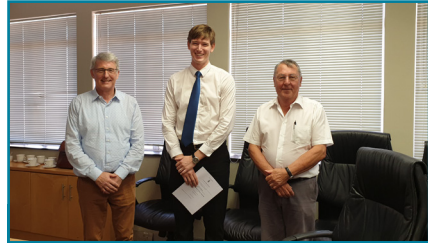
Van der Merwe's thesis focused on visualisation techniques within the finance space and on credit spreads.

"My supervisors and examiners had a significant influence on the success and quality of the overall thesis and I am also thankful for the support of the University, Faculty, and Department during the joint PhD, both with funding and time," he said.

Buitendag, who worked as a data scientist before joining Capitec, received his joint doctorate in Mathematical Statistics at SU and in Mathematics at KU Leuven. His supervisors were Professors Tertius de Wet (SU) and Jan Beirlant (KU Leuven).

"The joint PhD exposed me to the dynamics of world-leading research institutions and researchers, which contributed a great deal to my mentality, academic skillset and the quality of research that I got involved with and produced," said Buitendag.

He attributed the success of his studies to his supervisors, who provided direction and guidance along his academic journey.



Dr Sven Buitendag with his supervisors, Professors Jan Beirlant of KU Leuven (left) and Tertius de Wet of Stellenbosch University (right).

De Wet, professor emeritus and former chair of the Department, said: "Carel and Sven are outstanding students, both academically and in the way they could handle their new environments. They were, and still are, extremely good ambassadors for our Department, Faculty and University and they certainly created a very positive impression of the quality of our training and of our students."

He added that the experience of being exposed to a different environment, academic style, and thinking is extremely valuable to a young professional.

"It is a wonderful way of starting to build an international network of cooperation. Personally, I very strongly support such joint degrees."

Prof Paul Mostert, chair of the Department, said it was very important that the Department extended its international standing, especially with PhD research.

"These partnerships have resulted in a network of international collaborators that can benefit the teaching and research of the Department. To have two students, one a permanent academic, obtaining their joint PhD degrees from two different Belgian universities is a remarkable achievement. Awarding such degrees under these dual agreements is a first for the Department and hopefully a start for many more in the future."

The Department currently has another joint PhD candidate, Luca Steyn, enrolled with Ghent University. By March 2020, SU had awarded 39 joint PhD degrees. A total of 31 joint PhD candidates are currently enrolled at SU.



With **Dr. Carel van der Merwe** (in the middle) are (from left to right) **Professors Jan Annaert** (Antwerp University), **Michèle Vanmaele** (co-supervisor, Ghent University), **Koen Inghelbrecht** (supervisor, Ghent University), and **Patrick van Kenhove** (Dean of the Faculty of Economics and Business Administration, Ghent University).

## Discovering biplots

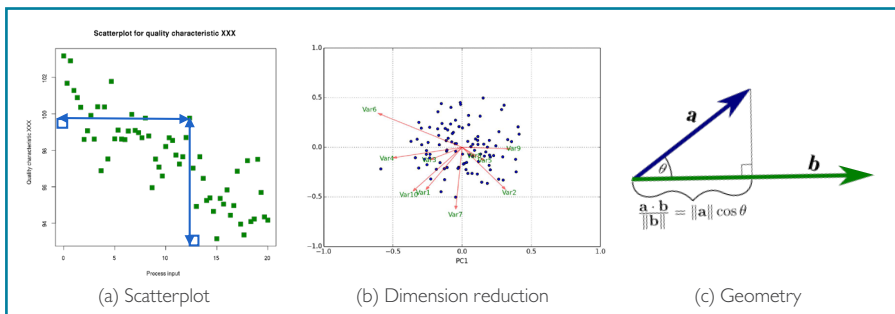
By: *Dr Carel van der Merwe*

My journey into biplots started with the completion of the first paper for my PhD. With its conclusion, an investigation was launched to find a suitable method for my second PhD paper. Biplots came to mind, since Stellenbosch University has two leading researchers in the field at our Department – Prof Niël le Roux and Prof Sugnet Lubbe, who also co-authored *Understanding Biplots*, one of two seminal works within the field of biplots. It was therefore an easy decision to try and incorporate this method of visualisation into my thesis – but first, I would need to understand exactly how it works.

I have previously seen these beautiful figures depicting multidimensional data – both variables and observations – all in a single plot but was still unsure whether I fully understood it. The first step was to speak with Prof Le Roux – the person that taught me Multivariate Statistics in my third year some 14 years ago.

In our initial discussion, I asked him to explain biplots to me in a simplistic non-mathematical manner. I wanted to get an idea of how one should interpret these plots first, before deciding if it would be useful for my research. Only then would I delve into more detail on how to build it. He explained that the foundation of biplots can be split into the three concepts, namely scatter plots, dimension reduction, and geometry.

A biplot essentially aims at simple visualisation and interpolation of the dataset by drawing perpendicular lines from the observations to the variable axes, much like a simplistic scatter plot. If  $X:n \times p$  is matrix with rank,  $r$ , then it can be written as  $X = AB$ , with  $A:n \times r$  and  $B:r \times p$ . Using this,  $X$  can be approximated with a matrix having a reduced rank equal to two, or rather  $\hat{X}:n \times p = \hat{A}\hat{B}$  with  $\hat{A}:n \times 2$  and  $\hat{B}:2 \times p$ . Various methods can be implemented to get the best approximation of  $X$  by  $\hat{X}$ . Once this approximation is done, two sets of two-



dimensional coordinates are obtained – one for the  $n$  data points and another for the  $p$  variables. These form the base input of the biplot construction, allowing simplistic interpretation to be done.

Now, as an explanatory example, two Canonical Variate Analysis (CVA) biplots of a medical research dataset are given below in figure 1. The dataset contains three classes into which someone could be classified, namely Disk Hernia, Spondylolisthesis, or Normal, based on six numerical covariates. These six covariates include Pelvic incidence (V1), Pelvic tilt (V2), Lumbar lordosis angle (V3), Sacral slope (V4), Pelvic radius (V5), and degree of Spondylolisthesis (V6). The biplot on the left contains a training data set with classification regions based on the shortest distance to the class mean, whilst the biplot on the right contains  $\alpha$ -bags, areas that enclose circa 95% of each class's observations. Note further that the "bi" in biplot implies that two properties are plotted, i.e. the observations and variables. As an extension, a triplot would therefore imply that three properties are depicted in a single plot. Therefore, a biplot with a classification area can also be referred to as a triplot.

From these two biplots some observations can be made:

- Linear boundaries might not provide the optimal classification in the biplot plotting space, as the classification boundaries might be more accurate if non-linear.

- Some variables have clear discriminatory power – such as V6, for which values larger than 20 mostly relate to the Spondylolisthesis class (imagine drawing perpendicular lines from each value on the axis and observe which of the points are in a majority along those perpendicular lines).
- While the full biplot space contains classification regions, points that fall far from the center of the biplot are most likely outliers and should not be classified into any of the classes.
- There are clear overlaps between some of the classes – such as the Normal and Disk Hernia classes and care should be taken when classifying points lying close to these regions.
- Lastly, the triplot is slightly cluttered and difficult to interpret for a non-seasoned biplot reader.

To address these shortcomings, the triplot with polybags was proposed. The triplot with polybags provides a simpler visualisation of the combined biplots pictured in figure 1. It provides an additional advantage through identifying areas with high risk of misclassification, either due to overlapping classes or outlier data points. The triplot with polybags also constructs the classification regions in the biplot space using all the training data points and not just the class mean.

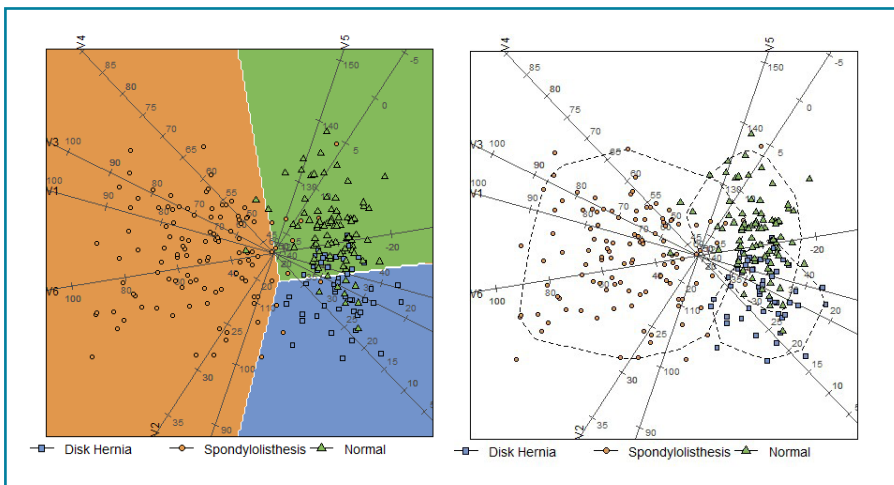


Figure 1: The CVA biplot of a medical data set. The biplot on the left contains classification regions based on the nearest class mean, while the biplot on the right contains 95%-bags indicating the concentration of the data. Both the biplots contain an 80% training set of the original dataset.

In figure 2 below there are two graphs. The first shows the triplot with the  $\alpha$ -bags used in the construction, while the figure on the right is slightly more refined. The classification regions were constructed using  $k$ -nearest neighbours with  $k = 21$ .

There are two sets of  $\alpha$ -bags in the left triplot. These are used to construct the inner and outer polybags which assist with the identification of areas with high risk of misclassification. The inner polybag is constructed by considering the intersection of the 95%-bags (the inner white space). The inner polybag allows for identification of overlapping classes. The outer polybag is constructed by taking the complement of the union of inflated  $\alpha$ -bags. In the diagram below 1.5 multiple inflated 95%-bags were used and form the boundary of the classification regions. The outer polybag assists with identifying potential outliers.

In the diagram on the right, the axes are shifted parallel in a zoomed-out biplot and only the parts of the axes that relate to the outer polybag are shown on

the diagram. Additionally, the classification areas are projected onto each of the axes, allowing the reader to interpret the marginal effect of each of the variables. The predictivity of each variable together with their full names are also provided on the axes below or above the projected classification regions.

The triplot with polybags therefore allows the reader to interpret the classification regions more easily, whilst also enabling the reader to identify observations with high risk of misclassification. Additional methods to draw the classification regions were also incorporated.

This is only one way in which biplots can be expanded, and since the initial work that was done on this research, various other areas to expand biplots were identified.

While this article is only a glimpse of the potential use of biplots, I hope that it has sparked some interest into the use and potential further use thereof as it did for me!

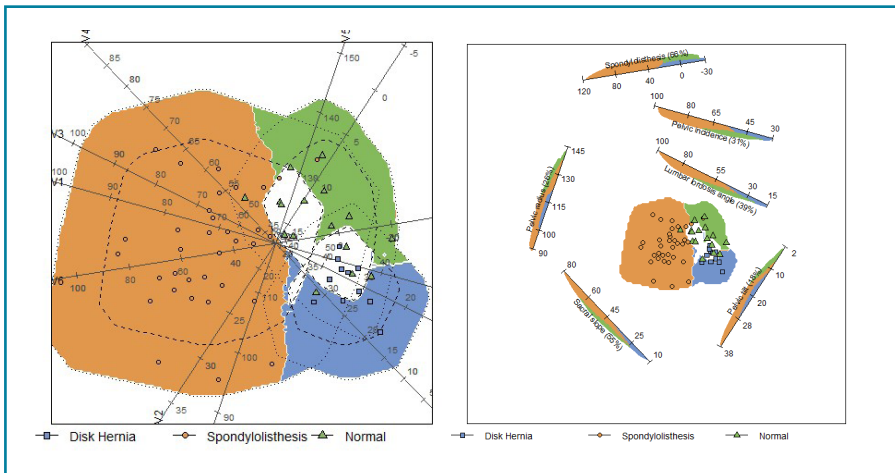


Figure 2: The CVA triplot with polybags constructed with a 20% test set of the medical data set. The CVA triplot was constructed with a 95% inner polybag, 1.5 x 95% outer polybag, and with underlying  $k$ -nearest neighbours with  $k = 21$ . The predictivity of each axis is given next to the variable name in the figure on the right.

## STAFF MATTERS

### Lecturing at KU Leuven – a wonderful opportunity



Between 2015-2019, Prof Niël le Roux had the privilege of lecturing at KU Leuven, Belgium's highest-ranked university. Founded in 1425, KU Leuven has been a centre of learning for almost six centuries and is one of the oldest and most renowned universities in Europe.

It all began when Prof Le Roux, professor emeritus, received an e-mail from Prof Marc Swyngedouw, full professor in Political Sociology and Methodology in the Faculty of Social Sciences at KU Leuven and founder of "Quantitative Analysis in the Social Sciences" (QASS), an advanced master's programme in Statistics.

"Prof Swyngedouw asked me to teach the Uni- and Multidimensional Scaling course in the 2015 academic year. This course is taught in the form of a block course in November every second year and since my duties at Stellenbosch University allowed me to be away for most of November 2015 I gratefully accepted Prof Swyngedouw's invitation.

**Prof Le Roux** recently received the honour of being elected as member of the International Statistical Institute (ISI). ISI elected membership is open to individuals who are established in their careers and have made significant contributions to the statistical profession.

"The content of the Uni- and Multidimensional Scaling course is in part similar to the Multidimensional course at SU, covering topics like Principal Component Analysis as a scaling technique, classical scaling, least squares scaling, metric and non-metric scaling as well as Procrustes Analysis. Biplots, of course, played a significant role in my presentation of the course. Specific applications of uni-dimensional scaling in Classical Test Theory (CLT), Item Response Theory (IRT) and Rasch modelling were also covered."

Prof Le Roux had 10 students in his class in 2015. He also taught the course in 2017 and 2019.

"The lectures and course administration followed the pattern of 2015. In both these years there were about twenty students attending classes. Apart from Belgium and the Netherlands, countries like Portugal, Spain, Germany, England, Italy, Croatia, Ukraine, Russia and French-speaking African countries were represented in the course."

While lecturing in Leuven, Prof Le Roux and his wife stayed in university accommodation in Het Groot Begijnhof.

"Het Groot Begijnhof is thought to have been established around 1232 as a community of religious women who settled outside the then city walls, on the riverbanks of the Dijle. In 1962, the University of Leuven bought the entire residential estate, with the exception of the church and a couple of houses that were only later transferred to the university. In 1998, UNESCO added Het Groot Begijnhof to the World Heritage list.

"To live in a city where cars must give way to bicycles and where you have World Heritage accommodation is like a dream come true," he concludes.



# STUDENT ACHIEVEMENTS

## Department congratulates third-year prize winners

Every year, the Department awards prizes to the best final-year student in each of the four subjects: Actuarial Science, Financial Risk Management, Mathematical Statistics and Statistics. In 2020, the prizes were awarded to Ms Jamie Stolk (Actuarial Science and Mathematical Statistics), Mr Samuel Sendzul (Financial Risk Management) and Mr Ben Rayner (Statistics).



Photo credit: Anton Jordaan

FLTR: **Clive Charlton** (Amazon), **Jamie Stolk** (prize winner), **Benjamin Rayner** (prize winner), **Samuel Sendzul** (prize winner), **Prof Ronel du Preez** (Vice-dean: Teaching and Learning) and **Prof Paul Mostert** (Head of the Department).

### Statistics: Mr Ben Rayner

Mr Rayner grew up in Cape Town before moving to Johannesburg when he was 16, where he matriculated from St David's Marist Inanda. He has a passion for investment management and would love to apply the statistical knowledge that he has gained to a career in this industry. He also plans on completing the CFA programme in the coming years.

#### Why did you decide to study Statistics?

I love working with analytical problems and have always enjoyed trying to interpret numbers. I have enjoyed learning how to create models and interpret datasets and believe that this subject has taught me many relevant skills that will provide me with opportunities in the future.

#### What postgraduate degree are you busy with?

I am currently enrolled in the BCom Honours degree in Statistics. I would love to further my knowledge in the ever-growing field of Statistics and fine-tune my skills in analysing data. I believe that this Department is full of the experts and knowledgeable resources that I need to help me develop new skills and grow my knowledge.

#### What do you like most about the Department and your postgraduate programme?

I love how relevant the programme is. We are constantly learning how to use different statistical software programs and how to analyse different types of data. The programme has also helped to enhance my analytical skills by teaching me how to approach various types of problems. The practical side of the programme is what I believe sets it apart from any other and I believe the skills that we are learning will benefit me in the future.

#### Do you think Statistics is a useful subject that can bring change to our society at large?

Yes, Statistics is such a useful and important field for so many industries in our society. The need to collect, analyse, and effectively interpret data could play a huge role in changing our society. We live in an ever-changing world that depends on information and data. Given the abundance of data, I believe that there is a massive need to process this information to make effective and accurate decisions. Whether it be in finance, sport, medicine or pretty much any industry, Statistics does and will always play a huge role in our society.

## **Mathematical Statistics and Actuarial Science: Ms Jamie Stolk**

Ms Stolk grew up in George and matriculated from Glenwood House Secondary School. She doesn't have a year-to-year career plan yet, just a set of broad goals for the next few years. She is currently enrolled for her honours degree in Actuarial Science.

*Why did you decide to study Actuarial Science and what do you like most about it?*

I enjoy looking into problems and forming strategies – especially in the corporate sphere – which is a big part of Actuarial Science.

*What did you like most about Mathematical Statistics?*

It's cool to see how the work we did applies to so many different fields – from working out the rate at which cells cross a membrane to modelling financial time series.

*What do you like most about the Department and your postgraduate programme?*

The course is a challenge – it makes you think (hard), figure things out and solve difficult problems.

*Do you think Actuarial Science is a useful subject that can bring change to our society at large?*

Sure. If you look at the contributions actuaries have made to fields like insurance, demographic modelling, etc. in the past, and how the field is adapting to meet the needs and demands in society today – I'm excited to see how the field develops even more in the future.

## **Financial Risk Management: Mr Samuel Sendzul**

Mr Sendzul grew up in Paarl and matriculated from Bridge House. He plans to work as a data scientist/data analyst, hopefully in a financial environment, where he can test his skills and earn enough seed capital to bring his entrepreneurial ideas to life. He started his own business called Outlines Art Collective that creates affordable prints of art made by university students with the aim of selling these prints to other students so that they can outfit their rooms in a beautiful, affordable way.

*Mr Sendzul is one of three recipients of the 2020 WA Hofmeyr Bursary for postgraduate study in the Faculty of Economics and Management Sciences.*

*Why did you decide to study Financial Risk Management and what do you like most about it?*

I was given the advice to pursue a career in asset management given my inclination for Mathematics and love for Economics in high school. I decided on Financial Risk Management as it was a degree that I knew would challenge me whilst providing me with the necessary skills I needed.

*What postgraduate degree are you busy with?*

BCom Hons (Mathematical Statistics). Throughout my undergraduate degree, my interest in Mathematical Statistics grew so much so that I decided to pursue my honours degree in it. I've since amended my career trajectory to become more data science focused, while still having the option to apply the new skills I will learn this year in a Financial Risk Management environment.

*What do you like most about the Department and your postgraduate programme?*

I enjoy the research assignment most as it gives me an opportunity to work on a real-life statistical learning problem in a team with quality supervision. I am lucky enough to be pursuing a Capitec-presented research project and am enjoying the skills I am learning and the insights I am gaining.

*Do you think Financial Risk Management is a useful subject that can bring change to our society at large?*

I believe sound Financial Risk Management practices are at the centre of protecting our current economic system from catastrophic failure. It can also be used to alleviate poverty through the redistribution of working capital to entrepreneurs – an idea especially relevant in South Africa today.





# STUDENT ACHIEVEMENTS

## PhD graduates



**Name of student:** Dr Sven Buitendag  
**Degree:** PhD (Mathematical Statistics [SU] and Mathematics [KU Leuven])  
**Supervisors:** Prof T de Wet and Prof J Bierlant  
**Title of thesis:** Extreme Quantile Inference

### Abstract:

New bias-reduced estimators for the extreme value index and novel confidence intervals for extreme quantiles are proposed. Furthermore, multivariate risk measures based on center-outward quantiles are proposed, including an estimator for the extreme value index for multivariate regularly varying distributions.

**Hyperlink to thesis** <http://hdl.handle.net/10019.1/107808>



**Name of student:** Dr Johané Nienkemper-Swanepoel  
**Degree:** PhD (Mathematical Statistics)  
**Supervisors:** Prof NJ le Roux and Prof S Lubbe  
**Title of thesis:** Biplot methodology for analysing and evaluating missing multivariate nominal scaled data

### Abstract:

The statistical analysis of data containing missing observations is a big challenge. Three core methodologies, namely categorical data analysis, missing data analysis and biplot visualisation, were combined to develop novel procedures to address this challenge. An extensive simulation study was conducted to evaluate the proposals. Guidelines to assist in the correct handling and unbiased visualisation of multivariate categorical missing data were established for technical and non-technical practitioners. Furthermore, the new methodology allows for the identification of the underlying missing data mechanism through visualisation. This research culminated in a tool pack to equip the modern data analyst with essential skills to deal with missing observations.

**Hyperlink to thesis** <https://scholar.sun.ac.za/handle/10019.1/107027>



**Name of student:** Dr Carel van der Merwe  
**Degree:** PhD (Mathematical Statistics [SU] and Economics [Ghent University])  
**Supervisors:** Prof T de Wet (SU) & Prof K Inghelbrecht (Ghent University)  
**Co-supervisors:** Prof WJ Conradie (SU) & Prof M Vanmaele (Ghent University)  
**Title of thesis:** Classifying yield spread movements in sparse data through triplots

### Abstract:

This dissertation investigated how yield spread movements of unlisted debt could be classified through the use of triplots. The dissertation consisted of three parts: the first provided a method to extrapolate the risk-free curve in sparse data environments, the second proposed a new classification technique that uses biplots with polybags which allows for the limitation of the classification error, and the final part used the results of the first two papers and applied it to South African yield spread data.

**Hyperlink to thesis** <https://scholar.sun.ac.za/handle/10019.1/107750>

# STUDENT ACHIEVEMENTS

## Master's graduates



**Name of student:** Mr Dylon Botha  
**Degree:** MCom (Statistics)  
**Supervisor:** Dr F Kamper  
**Co-supervisor:** Dr S Bierman  
**Title of thesis:** Discriminant analysis using sparse graphical models

### Abstract:

A novel classification technique which aims to relax the assumption of normality in quadratic discriminant analysis is proposed. The normality assumption is relaxed through the use of Gaussian copulas where the marginals are estimated using kernel density estimation. To combat the large number of parameters to estimate, regularisation on the class inverse covariance matrices is performed by means of the graphical lasso. An empirical comparison with other popular classifiers shows this classification method to be competitive.

**Hyperlink to thesis** <https://scholar.sun.ac.za/handle/10019.1/107978>



**Name of student:** Ms Bronwyn Dumbleton  
**Degree:** MSc (Mathematical Statistics)  
**Supervisor:** Dr S Bierman  
**Title of thesis:** Recommender Systems

### Abstract:

A review of standard and more modern approaches to recommender systems is given, including content-based filtering, collaborative filtering, and latent factor models for collaborative filtering. Towards a proposal for explainable recommendations, the link between the recommender problem and multi-label classification is discussed. Empirical work in this study includes an investigation of the use of interpretable multi-label classification approaches for recommendations, and an analysis of the effect of data sparsity on various recommender algorithms.

**Hyperlink to thesis:** <https://scholar.sun.ac.za/handle/10019.1/107114>



**Name of student:** Mr Michail Melonas  
**Degree:** MCom (Mathematical Statistics)  
**Supervisor:** Dr D Hofmeyr  
**Title of thesis:** Projected Naïve Bayes

### Abstract:

Naïve Bayes is a well-known statistical model that is recognised by the IEEE as being among the top ten data-mining algorithms. It performs classification by making the strong assumption of class conditional mutual statistical independence. Although this assumption is unlikely to be an accurate representation of the true statistical dependencies, naïve Bayes nevertheless delivers accurate classification in many domains. This success can be related to that of linear regression providing reliable estimation in problems where exact linearity is not realistic. There is a rich

body of literature on the topic of improving naïve Bayes. This dissertation is concerned with doing so via a projection matrix that provides an alternative representation for the data of interest.

**Hyperlink to thesis** <http://hdl.handle.net/10019.1/107862>

# STUDENT ACHIEVEMENTS

## Master's graduates



**Name of student:** Mr Nicholas Meyer  
**Degree:** MCom (Mathematical Statistics)  
**Supervisor:** Prof DW Uys  
**Title of thesis:** Strategies for combining tree-based learners

### Abstract:

This dissertation investigates the weighting of simpler base learners in tree-based ensemble methods for regression. A regularised weighted model, based on convex optimisation, is proposed. The proposed model is compared to established ensemble techniques, such as bagging and the random forest, in simulated, as well as in real-world datasets. The proposed method yields favourable results if compared to these ensemble techniques.

**Hyperlink to thesis** <http://hdl.handle.net/10019.1/107930>



**Name of student:** Ms Maria N Nambandi  
**Degree:** MCom (Statistics)  
**Supervisor:** Dr F Kamper  
**Title of thesis:** Short-Term wind speed prediction using various forecasting methods

### Abstract:

This thesis investigates the problem of short-term wind speed prediction by considering various forecasting methods. The data under consideration was obtained from the Jozini and Memel wind sites in South Africa. The purpose of this thesis was to establish how different artificial neural network architectures compare to traditional time series models, when predicting wind speeds over a 1-to-24-hour forecasting horizon. The empirical results showed regression with Fourier terms and ARMA errors to be a competitive forecasting model.

**Hyperlink to thesis** <https://scholar.sun.ac.za/handle/10019.1/107757>



**Name of student:** Mr Zander Wessels  
**Degree:** MCom (Statistics)  
**Supervisor:** Dr MMC Lamont  
**Title of thesis:** Interpreting decision boundaries of deep neural networks

### Abstract:

Deep neural networks are known for their highly competitive prediction accuracies, but also infamously for their "black box" properties when it comes to their decision-making process. Tree-based models on the other end of the spectrum are highly interpretable models, but lack the predictive power with certain complex datasets. The proposed solution of this thesis is to combine these two methods and obtain the predictive accuracy from the complex learner, but also the explainability from the interpretable learner.

**Hyperlink to thesis** <http://hdl.handle.net/10019.1/107202>

# STUDENT ACHIEVEMENTS

## Master's graduates



**Name of student:** Ms Francesca van Niekerk

**Degree:** MCom (Financial Risk Management)

**Supervisor:** Dr CJ van der Merwe

**Title of thesis:** Estimating expected exposure profiles using biplot interpolation

### Abstract:

The accounting standards provide guidelines on how to determine the fair value for a financial asset or liability held at fair value. When considering the fair value of derivative instruments, some additional adjustments need to be made for counterparty credit risk. For interest rate swaps, in particular, one needs to calculate the effective exposure of the swap in order to make these adjustments. One of the most popular methods, albeit computationally intensive, is to calculate these exposures through Monte Carlo simulation. In this study an alternative method of calculating the effective exposure using biplot interpolation is proposed. In this proposed method, an analytical approach in approximating the effective exposure profile is implemented through fitting a beta function. The parameters for this beta function are then estimated through biplot interpolation, which in turn approximate the exposure profile. When the performance of the biplot interpolation approach was tested using a standard interval testing approach, the approximated biplot interpolated profile provided a reasonable approximation of the true profile.

**Hyperlink to thesis** <https://scholar.sun.ac.za/handle/10019.1/108142>



**Name of student:** Mr Peter-John Clift

**Degree:** MCom (Financial Risk Management)

**Supervisor:** Prof WJ Conradie

**Title of thesis:** Credit curve estimation and corporate bonds in the South African market

### Abstract:

Accurate fair value measurement of financial instruments serves as one of many mechanisms to enhance the integrity of financial institutions, particularly as it relates to counterparty credit risk. In this study, specific reference is made to credit spreads and the information that can be inferred from it for the purpose of fair value measurement. Market observable information, such as traded corporate bonds as well as accounting and share price information related to the issuers of these bonds are used in order to construct credit spread curves. These credit curves are used as an input to calculate the value of corporate bonds, but can also be used in the calculation of measures related to counterparty credit risk management like the probability of default and loss given default parameters.

Currently there is no market standard model that can generate these credit curves. In this study, several models are introduced that may be appropriate to model credit spreads, as well as considerations for their application across a range of possible issuers. The accuracy of each model is tested by using these models to price newly issued corporate bonds and evaluating the resulting price difference from what is observed in the market.

**Hyperlink to thesis** <http://hdl.handle.net/10019.1/108003>

## ALUMNI

### SU degree leads to Oxford studies



For alumna Nicole Lester, the Department of Statistics and Actuarial Science at Stellenbosch University offered a springboard to a master's degree at Oxford and a life in London. She completed her undergraduate and honours degrees in Actuarial Science between 2011-2014.

"I thoroughly enjoyed my time at the Department and at the University as a whole and feel that I was lucky to get a really solid education on both the personal and academic fronts. I had a lot of fun, learnt a lot about myself and made a great set of lifelong friends. I balanced that with a lot of time in the *bib*, and I really challenged myself academically. Looking back, I think the highlight for me was how connected the community was – there was always a friendly face on the *Rooiplein* and after a while, the town really felt like home."

She had always wanted to study abroad, and post-Stellenbosch went on to do an MSc in Statistical Science at the University of Oxford.

"I thoroughly enjoyed it there – it was a fantastic opportunity to meet intelligent, motivated, and interesting people from all around the world. I would highly recommend to anyone who has the inclination to study abroad to investigate the option – there is a misconception that these 'prestigious' universities are impossible to get into and if you went there you would have to work all the time to keep up, but that isn't the case."

Nicole's course focused on machine learning and more advanced Bayesian methods and she found herself very well prepared for the course work, given the high-quality education she received at Stellenbosch.

"In some ways it was largely the same – lecture-based with weekly tutorials. However, something that was quite different in comparison with the Stellenbosch courses is that Oxford does all assessment based on one exam and one thesis at the end of the year. This has definite advantages in that students have time to let the material sink in and actually learn, compared to constantly scrambling for tests, but it relies on a high degree of self-motivation."

She finished the year with a very fun thesis – predicting the location of TVs in US households using a random forest classifier on a massive dataset of ~50 million rows and ~30 parameters.

"I did this work for a large marketing and media company, and I am still unsure as to how they are using the work to build an actual data-science use case. However, I can confidently say that ~50% of TVs are in living rooms, and ~2% of homes have more than two TVs in the same room."

Post-Oxford, Nicole started working at Bain & Company in London, and she has been there now for just over two years.

"Although my work is completely unrelated to Actuarial Science, I believe some of the skills that I learnt as part of my Actuarial degree have equipped me well. Perhaps the most valuable of all was learning how to manage time in an effective way, and how not to let the stress of the volume of what needs to be done become crippling. I have the Actuarial Risk Management honours course to thank for that one!

"I enjoy my life in London – I live with two good friends in a flat opposite Hyde Park, and enjoy running outside and working out in the morning, especially doing Barry's Bootcamp and Barre classes. I love the foodie scene in London and travelling (Iceland was a highlight), but that is probably on pause for a little while. So, for now I am mastering the art of cooking at home (I have yet to bake bread, though) and am spending the weekends cycling around the streets of London.

"I feel very grateful to the Department at Stellenbosch University that was always supportive, engaged and helpful both during and after my degree. One of the best parts about the Department is its small, 'family feel' – I feel very lucky to have been a part of it."

## ALUMNI

### A different view on the world after Actuarial Science studies



In 2020, Maties alumna Anuchka Anderson returned to the Department of Statistics and Actuarial Science at Stellenbosch University to enroll for her honours degree after gaining some life experience in the showjumping world of Europe.

After three years of balancing her Actuarial studies with being a competitive showjumper, she wasn't sure whether she wanted to pursue an honours degree in Mathematical Sciences or Actuarial Science.

"I thought it best to find my feet in the working world and then, with experience behind me, decide what field I liked best. Although most lecturers are of the opinion that it is easy to get a job with an Actuarial degree, this was not the case. Being unemployed and unsure about what field I wanted to do my honours in, I was eventually led to Belgium."

Anuchka got the opportunity to compete and show jump horses in Belgium. As a young child, she had had the privilege to travel, but she didn't realise that she would be looking at the world through different eyes after her studies.

"Actuarial Science prepares you to see the world differently. Everything you see has a

value, a risk and a return. With every horse you are given to ride, you are potentially sitting on a horse with a value of between 10 000 and 300 000 euros. As with any investment, you must strike a balance between the amount of risk you take on and your expected return. The amount of risk you take on relates to how many times you jump your horse – with every jump your horse is exposed to impact on his front limbs of between 700 kg to 1500 kg, creating the optimal environment to blow a tendon. A blown tendon is an investment worth zero.

"In Belgium and Germany, they believe that one-third of your return is locked up in a horse's breeding. Certain horses have pedigrees dating back to the 1500s, making these horses a sought-after commodity."

According to Anuchka, the quality and number of horses at every show were amazing and the prize money was worth the travel and hours of training.

"Personally, my favourite venue is Vilamoura, Portugal. It's a small venue where everything is close together, every night entails festivities and the surface on which your horse jumps is a very good quality, which makes this tour a highlight in riders' summer calendars."

Towards the end of 2019, Anuchka got a job with Afrafin as a Financial Planner Assistant and she returned to South Africa. Accompanying her was her favourite horse, named Krack van den Overweg.

"Now I definitely know that there is a space for me in the Actuarial Science field. Belgium opened a world of numbers within my passion (showjumping) and I came back to Stellenbosch University to do my honours in Actuarial Science. While studying I am developing an insurance product for the competitive horse market, hopefully taking on the available opportunities within this emerging market."

## ALUMNI

### Fast-thinking alumnus wins quiz show



Blitsbrein presenter **Pietie Beyers** and **Daan du Plessis**.

Maties alumnus Daan du Plessis was the recent winner of *Blitsbrein*, a general knowledge quiz show on DSTV in which participants battle for the title of SA's top quiz brain. He also won *FiekNet Foendies*, a quiz show about films, in 2018.

Although *Blitsbrein* is broadcast once a week over three months, the entire season is recorded in one week. The winner from each episode stays on as the "Blitsbrein" for the next episode.

"My first three episodes were recorded in a single day. It's exhausting – you literally walk off the set, change your shirt, and the next episode starts recording. Then you have to speak to the TV audience as though the previous episode was filmed a week earlier. I only took three shirts with me and I had to wash all three on the first night so I could wear them again the following day!"

Even though he knew the final outcome, Daan says it was still tense to watch the show.

"The pace is terribly fast and you remember how you felt when you were standing there."

How does one prepare for a general quiz show?

"It's an almost impossible task, because they can ask questions about any topic."

He says he had a look at the type of questions they asked in previous seasons and drew up a few lists to memorise.

According to Daan, being there in person and competing is very different to giving answers while relaxing on the couch at home, but that he would recommend the experience to anyone who enjoys quizzing and who wants to test themselves against the best.

Daan studied Actuarial Science at Stellenbosch, obtaining his BCom degree with distinction in 2002 and his honours degree in 2003.

He qualified as a fellow of the Institute of Actuaries (FIA) in 2006 and works as a product development actuary at Sanlam Head Office in Bellville. He lives in Durbanville and is married to René, an internal auditor at TFG. Other than quizzing, he is a film enthusiast who loves to travel – when there isn't a global pandemic.

# CONFERENCE PROCEEDINGS

## CONFERENCES:

### **SOUTH AFRICAN STATISTICAL ASSOCIATION (SASA) CONFERENCE, 25-29 NOVEMBER 2019, PORT ELIZABETH**

Dumbleton, B.C. and Bierman, S. Factorisation Machines for Recommender Systems. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Du Plessis, N.M., Muller, C.J.B., Avenant, T., Pepper, M.S. and Goga, E. An Early Infant HIV Risk Score for Targeted HIV Testing at Birth. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Hofmeyr, D.P. Speeding up projection pursuit using fast kernel computations. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Kamper, F. An Introduction to Gaussian Belief Propagation. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Lubbe, S., Daniels, A., Opara, L., Nieuwoudt, H. and le Roux, N.J. A novel application of survival and competing risk models in agriculture. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Lubbe, S. Multivariate Data Analysis group (MDAG) Workshop: Visualisation of multivariate continuous data. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Lubbe, S. Multivariate Data Analysis group (MDAG) Workshop: Visualisation of multivariate continuous data. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Nienkemper-Swanepoel, J. Multivariate Data Analysis group (MDAG) Workshop: Categorical data: Visualisation and missing values. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Nienkemper-Swanepoel, J., le Roux, N.J. and Lubbe, S. Extended applications of GPAbin biplots. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Sandrock, G.K. Classification of musical instruments in audio samples. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Steyn, M.L. Open-set recognition with the Generalised Pareto Distribution. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Uys, D.W. Tree-based ensemble methods for classification. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

Van der Merwe, C.J. and de Wet, T. Classifying yield spread movements through triplots: a South African application. 61st Annual Conference of the South African Statistical Association, 25-29 November 2019, Port Elizabeth.

**Attended:** Surette Bierman, Tertius de Wet, David Hofmeyr, Francois Kamper, Sugnet Lubbe, Paul Mostert, Annegret Muller, Chris Muller, Daan Nel, Johané Nienkemper-Swanepoel, Trudie Sandrock, Luca Steyn, Danie Uys, Lienki Vijoen, Bronwyn Dumbleton, Michail Melonas, and Corine de Koker.

### **Highlights:**

- Dr Johané Nienkemper-Swanepoel won the Young Statisticians Student Oral competition at the SASA 2019 conference with her talk titled "Extended applications of GPAbin biplots".
- A GPAbin biplot is a visualisation technique for incomplete multivariate data. The GPAbin technique enables the optimal combining of biplot visualisations after multiple imputation has been applied to incomplete multivariate data. The technique was first developed for multiple correspondence analysis biplots for the visualisation of multivariate categorical data. In this presentation it was shown that the GPAbin approach can be successfully extended to log-ratio biplots for compositional data and also principal component analysis biplots for continuous data.



- Paul Mostert was awarded fellow membership of SASA
- Daan Nel was elected as an honorary member of SASA

### **THE 8TH INTERNATIONAL WORKSHOP ON COMPOSITIONAL DATA ANALYSIS (CODAWORK2019), 3-8 JUNE 2019, TERRASSA, SPAIN**

Le Roux, N.J., Nienkemper-Swanepoel, J. and Lubbe S. GPABin for data visualization in the presence of missing observations. CoDaWork2019, 3-8 June 2019, Terrassa, Spain.

**Attended:** Niël le Roux and Sugnet Lubbe

**Highlight:** Published conference proceeding: Le Roux, N.J., Nienkemper-Swanepoel, J & Lubbe, S. 2019. GPABin for data visualization in the presence of missing observations. In Egozcue, J.J, Graffelman, J & Ortego, MI (eds). Proceedings of the 8th International Workshop on Compositional Data Analysis (CoDaWork2019): Terrassa, 3-8 June, 2019. Universitat Politècnica de Catalunya-BarcelonaTECH, 91-97. ISBN 978-84-947240-2-2

### **DATA SCIENCE, STATISTICS & VISUALISATION (DSSV) 2019. SATELLITE CONFERENCE OF THE 62ND WORLD STATISTICS CONGRESS, 13-15 AUGUST 2019, KYOTO, JAPAN**

Le Roux, N.J., Rossouw, R. and Coetzer, R. Implementing a Biplot Based Multivariate Data Driven Industrial Performance Index. Data Science, Statistics & Visualisation 2019, 13-15 August 2019. Kyoto, Japan.

### **16<sup>TH</sup> CONFERENCE OF THE INTERNATIONAL FEDERATION OF CLASSIFICATION SOCIETIES (IFCS), 26-29 AUGUST 2019, THESSALONIKI, GREECE**

Ganey, R. and Lubbe, S. Visualising multivariate data in a principal surface biplot. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

Kidd, M. A multivariate ROC based classifier. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

Le Roux, N.J. and Gower J.C. Properties of individual differences scaling and its interpretation. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

Lubbe, S. Functional linear discriminant analysis for several functions and more than two groups. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

Nienkemper-Swanepoel, J., le Roux, N.J. and Lubbe, S. A simulation study for the identification of missing data mechanisms using visualisations. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

Sandrock, G.K. Local and global relevance of features in multi-label classification. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

Uys, D.W. Tree-based ensemble methods for classification. 16<sup>th</sup> Conference of the International Federation of Classification Societies, 26-29 August 2019, Thessaloniki Concert Hall, Thessaloniki, Greece.

**Attended:** Martin Kidd, Sugnet Lubbe, Niël le Roux, Trudie Sandrock, Danie Uys and Johané Nienkemper-Swanepoel

**Highlight:** Prof Niël le Roux was invited speaker with a presentation titled "Classification, visualisation and dimension reduction".

### **30<sup>TH</sup> JUBILEE MEETING OF THE VERENIGING VOOR ORDINATIE AND CLASSIFICATIE (VOC), DUTCH/FLEMISH CLASSIFICATION SOCIETY. 21-22 NOVEMBER 2019, WAGENINGEN, THE NETHERLANDS**

Le Roux N.J., Rossouw, R. and Coetzer, R. Implementing a Biplot Based Multivariate Data Driven Industrial Performance Index. 30<sup>th</sup> Jubilee meeting of the Vereniging voor Ordinatie and Classificatie (VOC), Dutch/Flemish Classification Society, 21-22 November 2019, Fletcher Hotel-Restaurant De Wageningsche Berg, Wageningen, The Netherlands.

**Attended:** Sugnet Lubbe and Niël le Roux

**Highlight:** Prof Niël le Roux was an invited speaker.

## INTERNATIONAL SOCIETY FOR CLINICAL BIOSTATISTICS CONFERENCE, 4-8 JULY 2019, BELGIUM

Kotze, L. & Mostert, P.J. (2019). Markov Modelling of Disease Progression in the Presence of Missing Covariates (ISCB40), Leuven, Belgium, July 2019.

## THE 3RD BRICS MATHEMATICS CONFERENCE, 21-26 JULY 2019, INNOPOLIS UNIVERSITY, RUSSIA

De Wet, T. Confidence intervals for extreme pareto-type quantiles. The 3rd BRICS mathematics conference, 21-26 July 2019, Innopolis University, Russia

**Highlight:** Prof Tertius de Wet was commissioned by the South African Statistical Association to present at the conference. The BRICS conference in Mathematics consists of three main streams, including Mathematics, Applied Mathematics, and Statistics. Each of the BRICS countries sends one representative of each of these three streams to present at the BRICS conference. The conference was held in Innopolis – a new university town which is one hour's drive from Kazan. Kazan is the capital and largest city of the Tatarstan in Russia. Stellenbosch University is set to host the 2021 BRICS conference.

### DEPARTMENTAL SEMINARS:

Dr Johané Nienkemper-Swanepoel presented a seminar titled "A missing data journey with multiple correspondence analysis applications" at the Department of Statistics and Population Studies, University of the Western Cape.

Luca Steyn presented a seminar titled "Open-set recognition with the Generalised Pareto Distribution" at the Department of Data analysis and mathematical modelling, Ghent University.

## DEPARTMENTAL SEMINARS

SEMINAR PROGRAMME: SECOND SEMESTER 2020	
Stellenbosch University Department of Statistics and Actuarial Science	
31 July	<b>Adriaan van Niekerk</b> (Centre for Geographical Analysis, SU) <i>The use of machine learning for making sense of satellite imagery</i>
14 August	<b>Gerrit Grobler</b> (Department of Statistics, NWU) <i>An empirical analysis of currency jumps based on realised bi-power variation</i>
28 August	<b>Francois van der Bank</b> (Department of Industrial Psychology, SU) <i>Using structural equation modelling to explain psychological mechanisms at work</i>
11 September	<b>Kristian Muller-Nedebock</b> (Department of Physics, SU) <i>Disorder in polymer networks</i>
2 October	<b>Carel van der Merwe</b> (Department of Statistics and Actuarial Science, SU) <i>Classifying yield spread movements in sparse data through tri-plots</i>
16 October	<b>Musa Malwandla</b> (Differential Capital, Johannesburg) <i>Issues in consumer credit risk: from regulatory capital to economic value</i>

Seminars that are permitted to be held on campus will start at 13:00 in room 2048 of the Van der Sterr Building, c/o Victoria and Bosman Streets, Stellenbosch. Seminars that are not permitted to be held on campus will be arranged via Microsoft Teams or Zoom. These seminars will also start at 13:00.

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## PUBLISHED PAPERS

### PUBLISHED PAPERS IN PEER-REVIEWED JOURNALS

#### BY PERMANENT ACADEMIC STAFF

- Abdulgader, S.M., Robberts, L., Ramjith, J., Nduru, P.M., Dube, F., Gardner-Lubbe, S., Zar, H.J. and Nicol, M.P., 2019. Longitudinal population dynamics of *Staphylococcus aureus* in the nasopharynx during the first year of life. *Frontiers in genetics*, 10.
- Bierman, S., 2019. Interpretable multi-label classification by means of multivariate linear regression. *South African Statistical Journal*, 53(1), pp.1-13.
- Buitendag, S., Beirlant, J. and de Wet, T., 2019. Ridge regression estimators for the extreme value index. *Extremes*, 22(2), pp.271-292.
- Du Plessis, N.M., Muller, C.J., Avenant, T., Pepper, M.S. and Goga, A.E., 2019. An early infant HIV risk score for targeted HIV testing at birth. *Pediatrics*, 143(6), p.e20183834.
- Hofmeyr, D.P., Pavlidis, N.G. and Eckley, I.A., 2019. Minimum spectral connectivity projection pursuit. *Statistics and Computing*, 29(2), pp.391-414.
- Hofmeyr, D.P. and Pavlidis, N.G., 2019. PPCl: an R Package for Cluster Identification using Projection Pursuit. *The R Journal*, 11(2), pp.1-25.
- Hofmeyr, D.P., 2019. Improving Spectral Clustering Using the Asymptotic Value of the Normalized Cut. *Journal of Computational and Graphical Statistics*, 28(4), pp.980-992.
- Kajee, Z., Harvey, J. and Zöllner, E.W., 2019. The impact of a diabetes care team on the glycaemic control of paediatric and adolescent patients with type 1 diabetes mellitus at Tygerberg Children's Hospital. *South African Journal of Child Health*, 13(1), pp.11-16.
- Kamper, F., Steel, S.J. and du Preez, J.A., 2019. On the convergence of Gaussian belief propagation with nodes of arbitrary size. *Journal of Machine Learning Research*, 20(165), pp.1-37.
- Langenegger, E.J., Hall, D.R., Mattheyse, F. and Harvey, J., 2019. The impact of an obstetrician-led, labor ward critical care unit: A prospective comparison of outcomes before and after establishment. *Obstetric Medicine*, p.1753495X19838193.
- Minkah, R. and de Wet, T., 2019. Comparison of Confidence Interval Estimators: An Index Approach. *Journal of Applied Probability*, 14(1), pp.31-55.
- Ojo-Okunola, A., Claassen-Weitz, S., Mwaikono, K.S., Lubbe, S., Stein, D.J., Zar, H.J., Nicol, M.P. and du Toit, E., 2019. Influence of socio-economic and psychosocial profiles on the human breast milk bacteriome of South African Women. *Nutrients*, 11(6), 1390.
- Van der Spuy, P., Lenner, R., de Wet, T. and Caprani, C., 2019, August. Multiple lane reduction factors based on multiple lane weigh in motion data. *Structures*, 20, pp.543-549.

#### FROM THE CENTRE FOR STATISTICAL CONSULTATION

- Albien, A.J., Kidd, M., Naidoo, A.V. and Maree, J.G., 2020. Mixed-methods analysis of the applicability of the Career Adapt-Abilities Scale for isiXhosa-speaking South African township adolescents. *International Journal for Educational and Vocational Guidance*, 20(1), pp.1-29.
- Andrae, C.D., Smit, D.P., Makhoba, N.S., Kidd, M., Walz, G. and Chegou, N.N., 2019. Identification of Potential Biomarkers in Peripheral Blood Supernatants of South African Patients with Syphilitic and Herpetic Uveitis. *Ocular immunology and inflammation*, pp.1-9.
- Breet, E., Kidd, M., McGregor, N.W., Stein, D.J. and Lochner, C., 2019. Suicide ideation and attempts in obsessive-compulsive disorder. *Annals of clinical psychiatry: official journal of the American Academy of Clinical Psychiatrists*, 31(2), pp.192-199.
- Cluver, C.A., Charles, W., van der Merwe, C., Bezuidenhout, H., Nel, D., Groenewald, C., Brink, L., Hesselman, S., Bergman, L. and Odendaal, H., 2019. The association of prenatal alcohol exposure on the cognitive abilities and behaviour profiles of 4-year-old children: a prospective cohort study. *BJOG: An International Journal of Obstetrics & Gynaecology*, 126(13), pp.1588-1597.
- De Smidt, J.J.A., Odendaal, H.J., Nel, D.G., Nolan, H., Du Plessis, C., Brink, L.T. and Oelofse, A., 2019. In utero teratogen exposure and cardiometabolic risk in 5-year-old children: a prospective pediatric study. *The Journal of Maternal-Fetal & Neonatal Medicine*, pp.1-10.
- Grant, K.A., Myburgh, E.J., Murray, E., Pienaar, F.M., Kidd, M., Wright, C.A. and Kotze, M.J., 2019. Reclassification of early stage breast cancer into treatment groups by combining the use of immunohistochemistry and microarray analysis. *South African Journal of Science*, 115(3-4), pp.1-6.

## PUBLISHED PAPERS

- Kalungi, A., Womersley, J.S., Kinyanda, E., Jobola, M.L., Ssembajjwe, W., Nsubuga, R.N., Levin, J., Kaleebu, P., Kidd, M., Seedat, S. and Hemmings, S., 2019. Internalizing mental disorders and accelerated cellular aging among HIV+ children and adolescents in Uganda. *Frontiers in Genetics*, 10, p.705.
- Mafata, M., Brand, J., Panzeri, V., Kidd, M. and Buica, A., 2019. A multivariate approach to evaluating the chemical and sensorial evolution of South African Sauvignon Blanc and Chenin Blanc wines under different bottle storage conditions. *Food Research International*, 125, p.108515.
- Malisa, R., Schwella, E. and Kidd, M., 2019. From 'government' to 'governance': A quantitative transition analysis of urban wastewater management principles in Stellenbosch Municipality. *Science of The Total Environment*, 674, pp.494-511.
- Manngo, P.M., Gutschmidt, A., Snyders, C.I., Mutavhatsindi, H., Manyelo, C.M., Makhoba, N.S., Ahlers, P., Hiemstra, A., Stanley, K., McAnda, S. and Kidd, M., 2019. Prospective evaluation of host biomarkers other than interferon gamma in QuantIFERON Plus supernatants as candidates for the diagnosis of tuberculosis in symptomatic individuals. *Journal of Infection*, 79(3), pp.228-235.
- Martin, L., Kidd, M. and Seedat, S., 2019. The effects of childhood maltreatment and anxiety proneness on neuropsychological test performance in non-clinical older adolescents. *Journal of affective disorders*, 243, pp.133-144.
- McClunlan, K., Nel, D.G., Dhansay, M.A. and van Niekerk, E., 2019. Effect of Nutritional Intake on the Body Composition of HIV-Exposed and HIV-Unexposed Preterm and Low Birth Weight Infants. *Breastfeeding Medicine*, 14(3), pp.144-153.
- Mihnea, M., Alexandre-Tudó, J.L., Kidd, M. and du Toit, W., 2019. Basic in-mouth attribute evaluation: A comparison of two panels. *Foods*, 8(1), p.3.
- Odendaal, H., Kieser, E., Nel, D., Brink, L., du Plessis, C., Groenewald, C., Lucchini, M., Fifer, W.P. and Myers, M.M., 2019. Effects of low maternal heart rate on fetal growth and birthweight. *International Journal of Gynecology & Obstetrics*, 146(2), pp.250-256.
- Petrovic, G., Kidd, M. and Buica, A., 2019. A statistical exploration of data to identify the role of cultivar and origin in the concentration and composition of yeast assimilable nitrogen. *Food chemistry*, 276, pp.528-537.
- Ronacher, K., Chegou, N.N., Kleynhans, L., Siawaya, J.F.D., du Plessis, N., Loxton, A.G., Maasdorp, E., Tromp, G., Kidd, M., Stanley, K. and Kriel, M., 2019. Distinct serum biosignatures are associated with different tuberculosis treatment outcomes. *Tuberculosis*, 118, p.101859.
- Saif, O., Kansky, R., Palash, A., Kidd, M. and Knight, A.T., 2019. Costs of coexistence: understanding the drivers of tolerance towards Asian elephants *Elephas maximus* in rural Bangladesh. *Oryx*, pp.1-9.
- Spies, G., Kidd, M. and Seedat, S., 2019. A factor analytic study of the Childhood Trauma Questionnaire-Short Form in an all-female South African sample with and without HIV infection. *Child abuse & neglect*, 92, pp.157-166.
- Springer, P.E., Slogrove, A.L., Kidd, M., Kalk, E., Bettinger, J.A., Esser, M.M., Cotton, M.F., Zunza, M., Molteno, C.D. and Kruger, M., 2019. Neurodevelopmental and behavioural outcomes of HIV-exposed uninfected and HIV-unexposed children at 2–3 years of age in Cape Town, South Africa. *AIDS care*, pp.1-9.
- Ventimiglia, I., Van der Watt, A.S.J., Kidd, M. and Seedat, S., 2020. Association between trauma exposure and mood trajectories in patients with mood disorders. *Journal of affective disorders*, 262, pp.237-246.
- Vermooten, N., Boonzaier, B. and Kidd, M., 2019. Job crafting, proactive personality and meaningful work: Implications for employee engagement and turnover intention. *SA Journal of Industrial Psychology*, 45(1), pp.1-13.
- Visser, J., Knight, K., Philips, L., Visser, W., Wallace, M., Nel, D.G. and Blaauw, R., 2019. Determinants of serum 25-hydroxyvitamin D levels in healthy young adults living in the Western Cape, South Africa. *South African Family Practice*, 61(4), pp.150-158.
- Young, S.Y., Kidd, M. and Seedat, S., 2019. Motor timing outcome differences between patients with alcohol-and/or cocaine use disorder in a rehabilitation program. *Timing & Time Perception*, 7(1), pp.48-70.

We hope you enjoyed this edition of the Department's newsletter.



Contact Elizna Huysamen (ekruger@sun.ac.za) to be added to the newsletter distribution list.