ISSN 1391 4395 MAY-AUG 2025

IASSL NEWSLETTER

"Statistical thinking is an essential component of informed citizenship."
- David Spiegelhalter

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Featured Segments

From IASSL President's pen

Dr. Rajitha M. Silva
President/IASSL

Over the past four months, I have had the privilege of witnessing first-hand the dedication, creativity, and professionalism that drive the Institute of Applied Statistics, Sri Lanka (IASSL). Each committee continues to play its vital role, ensuring that our institute thrives as a living, breathing body where every part contributes to collective strength.

The Academic and Training Committee (ATC) has been truly outstanding in carrying forward our educational mission. With record numbers of applications for the Diploma, Higher Diploma, and Certificate courses, alongside a series of highly successful short courses, the ATC has sustained both intellectual rigor and financial health. The recently held Graduation Ceremony at BMICH was a milestone, celebrating the achievements of our students and reinforcing IASSL's reputation as a hub of applied statistical training.

The Research and Development Committee (R & D) continues to serve as our backbone in applied research. The Postal Department Costing Project has advanced impressively, with large-scale data collection and digital innovations ensuring accuracy and efficiency. In addition, collaborations with the Medical Research Institute (MRI) on nutrition research highlight IASSL's growing role as a trusted partner in evidence-based policymaking.

The Statistics Popularization Committee (SPC) has amplified our voice nationwide. Teacher Training Workshops in multiple provinces have strengthened school-level teaching in probability and statistics. Plans for the IASSL STAT ReTreat 2025, which will bring together Statistics undergraduates and current student members, demonstrate the committee's commitment to bridging generations through shared passion for statistics.

The House and Finance Committee (H&FC) has kept our financial and operational systems steady and transparent. From ensuring prudent management of program revenues to streamlining bank operations, they provide the muscle and metabolism that allow all other committees to thrive without interruption.

The Editorial Board deserves special recognition for advancing both the Sri Lankan Journal of Applied Statistics (SLJAS) and our newsletters. In recent months, SLJAS has seen an increase in submissions from both local and international authors, reflecting its growing recognition, and has moved forward with the publication of the upcoming issue. At the same time, the newsletter has grown in depth and diversity, featuring academic and industry articles, student contributions, puzzles, and even profiles of pioneer statisticians. The Council has also endorsed efforts to prepare SLJAS for Scopus indexing, including restructuring the editorial board for greater subject and geographic diversity. These steps are vital for enhancing IASSL's international visibility and scholarly influence.

And yet, the true heart of IASSL remains its members—our volunteers, lecturers, researchers, students, and council members. Your energy is the pulse that sustains all these achievements. As we look ahead, let us continue this momentum. With our backbone strengthened by research, our lifeblood renewed through training, our voice amplified in schools and communities, our muscles steady in finance, and our vision sharpened through publications, IASSL is not just active—it is thriving.

Together, we will continue to grow, inspire, and lead.

President,
Institute of Applied Statistics, Sri Lanka (IASSL)

Editorial

Dr. Chathuri L. Jayasinghe
Editor/IASSL

Dear Readers,

It is with great pleasure that we present to you the second issue of the IASSL Newsletter for 2025. This issue brings together a diverse collection of contributions that reflect the breadth and depth of the statistical community in Sri Lanka and beyond.

From the academic front, we feature four thought-provoking articles: on interesting statistical notions, effective teaching tools, and timely applications of statistics in vaccine response. Professional statisticians contribute two engaging pieces: an introduction to actuarial careers aimed at undergraduates, and insights into Choice-Based Conjoint (CBC) analysis. Adding to this richness are contributions from emerging scholars: one article by a doctoral student and another by an undergraduate student, showcasing the voices of the next generation.

Beyond the articles, this issue continues to offer variety and engagement. Our Sudoku puzzle returns, as usual with a monetary prize for winners, alongside the announcement of the previous puzzle's winners.

We are pleased to introduce a new segment that highlights news from statistics departments and student subject societies. To begin, this issue features updates from the Department of Statistics at the University of Sri Jayewardenepura and its student society.

We are also launching another regular feature, "Spotlight on Statistical Pioneers," which will celebrate the contributions of leading statisticians. Our first spotlight is on Prof. Tim Swartz, whose work has inspired many in the field of sports analytics.

Finally, you will find coverage of IASSL events held between May and August 2025, as well as announcements of upcoming events for September to December 2025.

We hope this issue not only informs but also inspires you to explore, connect, and contribute further to the growth of our vibrant statistical community.

Happy reading!
Warm regards,
Editor,
Institute of Applied Statistics, Sri Lanka (IASSL)

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Strange but True: Some Interesting Examples from Probability and Statistics

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In my teaching career that spanned 34 years, the last two years, I would say, were the most exciting, still challenging. It is simply because I worked as a 'deep neural network of teaching' where I constantly improved my teaching while learning from teaching! In this article, I am happy to share some interesting examples that I came across while engaged in this process.

Example 1. [Application of exponential distribution. Source: Pitman's Probability]
Strontium 90 is a dangerous component of fallout from nuclear explosions. It has a half-life of 28 years.
If T is the time until decay of Strontium 90, what is the number of years after a nuclear explosion, before 99% of the Strontium 90 produced by the explosion has decayed?

To answer this question, we can use the following facts:

- This is an application of the exponential distribution.
- If T is the random lifetime (i.e., time until decay) of such an atom, then T has an exponential distribution with parameter λ per year.
- λ is obtained using the exponential survival function, $P(T > h) = e^{-\lambda h}$ with h being the 'half-life';
  i.e. $P(T > 28) = ½$ which gives $e^{-\lambda * 28} = ½$ ➡ $\lambda = 0.0248$ per year.

➡ If t is the required number of years, then t years after the explosion 1% is still remaining. [i.e. $P(T > t) = .01$].
$e^{-\lambda t} = 0.1$ ➡ $(-.0248)(t) = -4.6052$ ➡ **$t \approx 186$ years**.

Conclusion: It would take approximately 186 years before 99% of the strontium-90 produced by a nuclear explosion has decayed!

Example 2. [Popular Example on False Positives. Source: Devore's Probability and Statistics for Engineers and the Sciences, 9th edition]

Suppose a lab test on blood samples shows either positive or negative. It is known that 95% of people with a particular disease test positive; 2% of people without the disease also test positive (called false positives). Suppose 1% of the population actually has the disease. **What is the chance that a randomly chosen person from this population actually has the disease, given that his/her test is positive?**

Solution:
Let D denote disease and '+' denote positive result.
Then $P(D) = 0.01$; $P(D^c) = 0.99$; $P(+|D) = 0.95$; $P(+|D^c) = 0.02$
From Bayes' theorem,

$$P(D \mid +) = \frac{P(+|D).P(D)}{P(+|D).P(D)+P(+|D^c).P(D^c)} = \frac{(.95)(.01)}{(.95)(.01)+(.02)(.99)}$$ **= 0.32 or 32 %.**

Conclusion: It appears that, given that the person's test is positive, the chance of the person actually having the disease is 32%! Is this surprising? But it is true for this population under the given conditions because the disease is rare, with only 1% having the disease.

Example 3. [Application of probability in non-typical computer-intensive tasks. Source: Devore's Probability and Statistics for Engineers and the Sciences, 9th edition]

In October 1994, a flaw in a certain Pentium chip installed in computers was discovered that could result in a wrong answer when performing a division. The manufacturer claimed that the chance of any particular division being incorrect was only 1 in 9 billion, so that it would take thousands of years before a typical user encountered a mistake.
However, some non-typical computer-intensive tasks where a billion divisions are carried out over a short time are not outside reality in modern times. Assuming the 1 in 9 billion figure is correct, would the probability that at least one error occurs during a short time when a billion divisions are carried out be zero?

Solution:

P(at least one error) = 1 – P(no error)
= 1 – P(all 10^9 operations are error free) = 1 – $[1 – (1/9)*10^{-9}]^k$ where $k = 10^9$, using independence.
= 1 – $[0.999999999889]^k$ = 1 - 0.894938749 = **0.1051.**

Conclusion: In a non-typical computer-intensive task where one must carry out a billion divisions during a short time, it is not improbable to obtain an incorrect answer!

The above examples show some strange but true results in real life, well explained by the application of probability and statistics, under the given conditions and assumptions.

Statistical Modeling in Vaccine Effectiveness and Immune Response: Enhancing Sri Lanka's Immunization Programs

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Introduction

The public health experts have established an effective system to combat infectious diseases through vaccination which spreads across the entire world. Medical vaccines have effectively decreased disease occurrence along with mortality decreases for measles polio and influenza over multiple years. However, across different population vaccine effectiveness varies and several factors including viral mutations together with population attributes, environmental elements and individual immune system function affect its outcome.

Sri Lanka needs to modify its immunization programs in response to the rising dangers from COVID-19 and dengue and antimicrobial-resistant infections. The results from traditional vaccines trials present their initial findings about efficacy rates yet they do not sufficiently describe the actual population-wide outcomes because these data are subject to changes from immune deterioration combined with mutating viruses and human behavior patterns. Healthcare professionals heavily depend on advanced statistical modeling methods for performing true vaccine effectiveness analyses and both immunity pattern forecasting and immunization strategy optimization.

Policy makers and researchers can develop vaccination strategies along with vaccine and risk group identification knowledge through Bayesian models along with survival analysis and machine learning methods.This paper investigates the value of statistical methods together with their possible uses to improve Sri Lanka's vaccination initiatives.

Understanding Vaccine Effectiveness and the Role of Statistics

The effectiveness of a vaccine describes its ability to stop infections while also protecting patients from serious diseases and preventing virus spread across real-life environments. The measurement of vaccine effectiveness includes factors from real-world settings such as differences in immune response and exposure risks along with external environmental elements rather than vaccine efficacy testing which happens in controlled clinical trials.

The following elements determine how effective vaccine protection becomes:

- The evolution of viruses and their mutations including the recent COVID-19 Delta and Omicron variants result in a decrease of vaccine protection effectiveness.
- Immune system variability emerges because age alongside genetics and conditions and past infections and hereditary makeup determines vaccine response effectiveness for each person.
- Antibody levels decrease naturally with time which usually leads to the requirement of booster doses.
- Community-based vaccine effectiveness faces impact from three external variables consisting of public health regulations and vaccination rates together with demographic density.

Statistical models serve public health officials and researchers to evaluate vaccine efficiency by assessing prolonged immune responses while supporting data-based booster strategies, selective vaccination programs and disease control measures.

Key Statistical Methods in Vaccine Effectiveness Analysis

1. Bayesian Models for Vaccine Effectiveness Estimation

When applied to vaccine effectiveness estimation, Bayesian statistical methods enable researchers to improve their predictions through updating methods that use new data collections. The Bayesian statistical methods differ from frequentist methods because they use clinical trial information to update vaccine effectiveness estimates by analyzing real-world data in continuous fashion.

How Bayesian Models Work

The initial assumption in Bayesian models for vaccine effectiveness stems from past clinical trial evidence. The model adapts its estimates of vaccine effectiveness by processing available real-world measurements of infections combined with hospitalization statistics as well as antibody responses data.

Applications in Sri Lanka

- The Bayesian models use statistical analysis to study vaccine effectiveness between Sinopharm, Pfizer vaccines, AstraZeneca and Moderna vaccines in different Sri Lankan demographics. Policy changes regarding vaccination strategies become possible through the combination of hospital records with epidemiological research which lets policymakers respond to new variant developments and vaccine breakthroughs.
- Future dengue vaccinations present opportunities for Sri Lanka due to its high dengue disease burden. The long-term performance of the dengue vaccine becomes easier to predict using Bayesian models while the models identify optimal beneficiary demographics for vaccine administration.

The use of Bayesian models produces improved decision outcomes through its ability to measure risk levels and provide continuous insight of actual vaccine results.

2. Survival Analysis for Long-Term Immunity Prediction

Survival analysis serves as an essential statistical method which enables researchers to study vaccine induced immune durations using time dependent event data and protection durations prior to immunity decay or breakthrough infections.

How Survival Analysis Works

The estimation of survival models reveals when particular events (including loss of immunity and breakthrough infections) become possible over time. The Kaplan-Meier estimator together with the Cox proportional hazards model represents standard techniques for investigating vaccine duration.

Applications in Sri Lanka

- Sri Lanka can establish the best booster dose timelines for COVID-19 vaccines through population specific analysis of vaccine protection durations between health workers and elderly people.
- The country uses HPV vaccines to protect young females from developing cervical cancer through its vaccination program. Waves of vaccine effectiveness research can determine both timeframes of protection against infection as well as requirements for additional doses.
- The lifespan of vaccine immunity for measles and Hepatitis B immunizations can be estimated using survival models for deciding future booster strategies.

Survival analysis of vaccine information will help Sri Lanka provide enduring protection to its population and maximize cost-effectiveness for booster dose administration.

3. Machine Learning for Predicting Immune Response

The field of machine learning (ML) transforms immunology by processing extensive and complicated datasets to forecast personal immune system reactions along with vaccine success rates and infectious breakthroughs. Specific ML methods, such as random forests, support vector machines (SVM), and deep learning models (e.g., neural networks), are widely employed in this context. Random forests and SVMs are effective for classifying immune responses and identifying critical predictive features within large, complex datasets. Deep learning, particularly using neural networks, excels at recognizing intricate patterns and relationships in high-dimensional immunological data, such as single-cell sequencing or proteomics. These algorithms facilitate the identification of concealed patterns in immunological datasets, making them especially valuable for adaptive medicine and personalized vaccination strategies.

How Machine Learning Works

The implementation of ML models (Random Forest, SVM and Neural Network) requires massive amounts of data to function properly including:

- Genetic markers together with immune profiles help scientists predict how vaccines affect different patients.
- Evaluation of vaccination failure probability depends on clinical and demographic information sources.
- Data from the population serves to monitor actual vaccine results in real-time.

Applications in Sri Lanka

- The analysis of above mentioned ML models reveals which individuals among the population will require extra early booster doses depending on their personal immune responses alongside health-related factors.
- ML models, which have been mentioned, help predict disease outbreaks in real time by uniting vaccine coverage data with geographical disease surveillance to launch campaign of vaccination initiatives in danger zones.
- The major public health issue of dengue exists persistently in Sri Lanka. Through ML analysis the vaccine response patterns of diverse individuals become identifiable along with the elements that affect vaccine success rates.

The adoption of ML technology such as Random Forest, SVM and Neural Network as for immunization planning will help Sri Lanka shift to customized public health programs that boost vaccine outcomes.

Enhancing Sri Lanka's Immunization Programs with Statistical Modeling

The immunization program of Sri Lanka demonstrates good success with its high vaccination coverage that includes measles rubella and hepatitis B. The optimal development of vaccine strategies at present requires complex analytical methods because of challenges created by emerging viral mutants in addition to vaccine refusal behavior and funding limitations.

Furthering vaccine success in Sri Lanka can be achieved through statistical modeling implementation as follows:

- The real-time implementation of Bayesian updates should be used to improve vaccine effectiveness monitoring.
- Survival analysis enables prediction of the best interval between vaccine booster doses.
- ML enables the creation of customized immunization tactics based on predictive modeling methods.
- The organization will improve its outbreak prevention capabilities by using data-driven insights along with its vaccine allocation planning.

Health authorities in Sri Lanka can create dynamic vaccination policies through ML models that link EHRs and epidemiological surveillance data systems.

Conclusion

The ongoing evolution of infectious diseases requires statistical modeling because it helps optimize vaccine effectiveness together with vaccination strategies. Through the application of Bayesian models and survival analysis and machine learning approaches Sri Lanka will strengthen its public health choices and enhance both vaccine durability reviews and adapted immunization protocols. When implementing advanced statistical methods, it will be essential to have collaborative work between immunologists and both data scientists and public health policymakers. Sri Lanka achieves pandemic and epidemic resilience through data-driven immunization strategies which protect its population from diseases in forthcoming years.

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Reflections on the Relationships among Information Theory, Probability, and Statistics with an Overview of the Beauty of the World around them

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Introduction

In this short, non-technical article, we expect to make the interested reader aware of Information Theory as a subfield of Applied Mathematics, more precisely of Applied Probability, and its applications, especially in Statistics and related areas. Our aims are twofold: to popularize the possibilities of expanding theoretical boundaries by establishing links across the fields of Information Theory, Probability, and Statistics, and developing theory-driven, innovative applications. Moreover, we present interpretations of Information Theory in terms of Statistics. It also contains a broader discussion related to Information Theory and Statistics, which includes the applications of Information Theory in Statistics or applications of statistical concepts to Information Theory. Due to its highly interdisciplinary nature, Information Theory lies in the intersection of Mathematics, Statistics, Computer Science, and several other fields such as Physics, Biology, Economics, and Engineering, with applications in numerous areas. From another point of view, it also serves as a bridge between totally different disciplines, for example, Statistics and Physics, and unifies the theories therein.

Information Theory deals with two fundamental problems: How much can you compress data? Is there a limit? It is about the storage of information. And at what rate can you communicate over a noisy channel like a telephone cable efficiently and reliably? Is there a limit? It is about the transmission of information. Information theorists have developed rich mathematical models to address these issues: in the first case, the fundamental limit of data compression as “entropy,” and in the second, the limit as “capacity” of the communication channel. The concepts in Information Theory have also been very useful within Statistics, particularly in proving the optimality of statistical procedures. It should be noted that the use of Information Theory, however, is not limited only to showing impossibility results. In the sequel, we will explore some interesting key topics that lie in the intersection of Probability, Information Theory, and Statistics.

Statistics methods are basically of two types, namely descriptive and inferential. It can be considered as a methodology for extracting information from data, often under uncertainty. This extracted information can then be used to make data-driven decisions in various fields such as medicine, finance, government, and corporate sectors etc. Statistics play an important role in our day-to-day lives, although it is often not so visible. Probability and Statistics are two intertwined and inseparable disciplines, where Probability plays a key role in Statistics. The reason for this is that data in real life are rarely perfect, with associated uncertainty, and also because the aim is often to make an inference to a population based on a sample of values.

Information Measures and their Applications in Statistics

The key information functionals, also known as measures, in Information Theory are: entropy, mutual information, and relative entropy (Kullback-Leibler divergence) [1, 2]. In 1948, Claude E. Shannon, who was working in the Bell Laboratory in USA and is now considered as the father of Information Theory, published a paper titled “A Mathematical Theory of Communication” in the Bell Systems Technical Journal. In that paper, he introduced the above information measures and described how information can be quantified and measured in bits. In brief, he introduced several groundbreaking concepts that were influential enough to help change the world. The results related to channel coding including information transmission over a noisy communication channel and source coding or data compression including information storage were eminent and paved the path for the development of digital communication.

The concept of entropy plays a central role in Shannon's Information Theory, which was borrowed from Physics, more precisely Thermodynamics, and used in Statistical Mechanics as a measure of disorder. Shannon was clever enough to pick this nice concept and introduce it as a measure of information for the observations of a discrete random variable taking different values and distributed according to a probability distribution $P(X = x_i) = \mu_i$.
The entropy, usually denoted by H(X), was the only functional obeying the following three natural properties:

i) H(X) is non-negative; ii) for a given n, the uniform distribution maximizes H(X). iii) entropy has an additive property of successive information, which justifies the inclusion of the logarithmic function in the definition of entropy. The last property simply says that information can be summed component-wise. Entropy is defined, with base 2 logarithm, as

$$H(X) = \sum_{i=1}^{n} p_i \log \frac{1}{p_i}.$$

We extract the following interesting quote in Shannon's words about choosing the term entropy [3]:

'My greatest concern was what to call it. I thought of calling it 'information', but the word was overly used, so I decided to call it 'uncertainty'. When I discussed it with John von Neumann, he had a better idea. Von Neumann told me, 'You should call it entropy, for two reasons. In the first place, your uncertainty function has been used in statistical mechanics under that name, so it already has a name. In the second place, and more importantly, nobody knows what entropy really is, so in a debate you will always have the advantage.' - Claude E. Shannon (1916–2001)

Entropy is used to quantify the amount of uncertainty in a random event and, in turn, to quantify the amount of information in that event. If an event is extremely unlikely, it conveys more information, and if it has a high probability of occurrence, it conveys little information. So, we need to understand that the terms surprise, uncertainty, probability, information, and entropy have close connections with each other. It is obvious from the definition of entropy that it gives average or expected uncertainty or information. Entropy is also interpreted as a complexity measure for quantifying the randomness, chaotic nature, and complexity of complex systems. The maximum entropy principle is another useful concept in all related fields. Another quantity is cross entropy, which finds applications as a loss function for optimal solutions to problems in Statistics, Machine Learning, Data Science, Data Analysis, and related areas. The entropy is not a completely understood concept and requires more and more deep investigations across different disciplines.

Let us next introduce the **mutual information** functional. We consider two discrete random variables X and Y with a joint probability mass function $p(x,y)$ and marginal probability mass functions $p(x)$ and $P(y)$. Then the mutual information $I(X;Y)$ is defined, with base 2 logarithm, as

$$I(X;Y) = \sum_x \sum_y p(x,y) \log \frac{p(x,y)}{p(x)p(y)}.$$

In Information Theory, it is a central quantity in determining capacity of a communication channel and in Statistics it is a measure of the mutual dependence between the two random variables involved. It is used in research areas such as knowledge discovery, data mining and in many areas related to Statistics and Computer Science.
The third functional that is **relative entropy or Kullback-Leibler (KL) divergence (or distance or information)** between two probability mass functions p(x) and q(x) on the same sample space is denoted by *D(p\\q)* and defined as

$$D(p||q) = \sum_x p(x) \log \frac{p(x)}{q(x)}.$$

Mathematically, this is not a metric since it is not symmetric but is used as a distance function to measure the statistical dissimilarity between two distributions in many applications and is equally important in both Information Theory and Statistics. KL divergence is a special case of the more general concept of *f*-divergence, where *f* is a convex function, although more generalized divergence functions are available in the literature. In Probability Theory and Statistics, relative entropy is used in large deviations theory (via Stein's lemma, Sanov's theorem and other results) to characterize optimal error probabilities in hypotheses testing. With this definition, we see mutual information can be expressed using KL divergence demonstrating their interrelationship. The three quantities maximum likelihood, cross entropy and KL divergence are found central in machine learning and related applications.

We mention another important quantity, that is Fisher information introduced by the British Statistician Ronald Fisher (1890-1962), which plays a very important role in Statistics when working with parametric models and is also a key measure in Information Theory. Fisher information gives a clue to the amount of information a random variable carries about an unknown parameter of the model. It can be shown that Fisher information is related to relative entropy through a Taylor's expansion. In Statistics, we find this quantity in measuring the efficiency of an estimator in parameter estimation via the Cramer-Rao inequality. We find applications of Information Theory in nonparametric statistical inference also.

The above discussion demonstrates how the fundamental problems and tools of Information Theory relate to statistical practice and theory. We also mention the notion of information projection and its connections to the error exponents in hypothesis testing, principle of minimum description length, novel decompositions like independent component analysis, asymptotic equipartition property and the weak law of large numbers, central limit theorem, data processing inequality and Markovian property, exponential family, model selection methodologies like Akaike and Bayesian information criteria (AIC and BIC) as related concepts in the intersection of the three main fields – Information Theory, Probability and Statistics. More interesting and rigorous results in abstract Information Theory, for example, information spectrum methods, and applications can be found in the literature, which show the depth of the connections among the above fields.

The World around Information Theory, Statistics, and Probability

We include the following incomplete list of emerging subfields directly or indirectly related to applied and theoretical Statistics:

1. Statistical and Information Theoretic Learning [4].
2. Information Theory in Data Science.
3. Applications in Artificial Intelligence, Neural Networks, and Machine Learning.
4. Information Theory and Deep Learning.
5. Information Geometry, which connects Information Theory, Statistics, and Differential Geometry.

Future Trends

In this short account, we made an effort to showcase how and why Information Theory is important in Statistics. In some sense, Information Theory acts as a bridge connecting different research fields in natural sciences and beyond. This is truly a useful tool in searching novel inter-relationships in Statistics and among the disciplines currently considered far apart. There is no doubt that these relationships predict a kind of unification of different fields. We understand that there is more space in the quantum world, and most of the above relationships have been established between Quantum Information Theory and Quantum Statistics at present [5].

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From Theory to Practice: Teaching Linear Programming with Interactive Tools

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Optimization is a widely used technique in various fields, including engineering, finance, healthcare, logistics, and manufacturing. The purpose of using optimization is to find the best possible alternatives by maximizing efficiency, minimizing costs, or improving performance under specified conditions. Linear Programming, developed under Operations Research, is a versatile tool that can be applied to fulfil the mentioned purpose effectively.
First introduced in the 1940s, Linear Programming (LP) is a systematic approach for solving optimization problems. It is designed for models with linear objective and constraint functions. The purpose of linear programming is to maximize or minimize the given objective function subject to the underlined constraints.

Thus, the key components of an LP can be identified as follows (Taha, 2011):

1. Describe or define the decision variables that represent the unknowns to be determined,
2. Determine the objective function that reflects the goal of the problem (maximize/minimize), and
3. Specify the constraints that the solution must satisfy.

Why do students struggle with LP?
Real-world scenarios in diverse fields are explained and solved using LP in many books, e-books, websites, and e-learning platforms. Yet, students struggle to grasp the concepts behind LP for various reasons. Several key reasons behind this can be identified as follows:

1. Abstract mathematical formulation

Linear Programming Problems (LPPs) require knowledge in areas such as algebra, graphing, inequalities, and optimization topics that students may not have mastered. They may struggle to translate a real-world scenario into mathematical expressions involving an objective function and constraints (Angkotasan et al., 2024). Thus, students fail to see how LP concepts apply to real-life decision-making.

2. Difficulty in Visualizing Multi-dimensional Problems

Students often try to memorize procedures instead of understanding the logic or inference behind maximizing/minimizing, slack variables, or corner point methods. Although two-variable LP problems can be depicted on a graph, real-world problems often involve 3 or more variables, which are difficult to visualize.

3. Language and Word Problem Challenges

LP is a part of Operations Research, which many perceive as complex or intimidating. Even high-ability students may sometimes struggle with interpreting word problems and identifying relevant data for forming constraints and objectives (Angkotasan et al., 2024; Chinamasa, Nhamburo & Sithole, 2014). For example, they might misinterpret terms like "at least", "no more than", or "maximum profit", leading to incorrect model formulations.

4. Infrequent Practice and Feedback

Mastery of LPPs requires iterative practice with immediate feedback, which is often lacking in large classes and self-study. Without knowing whether they have correctly formulated and solved the model, students might lose confidence.

Interactive learning activities and assessment tasks will help overcome these difficulties. Some of the interactive activities performed in my lectures on linear programming are briefly presented.

Interactive Classroom Activities

1. Introductory sessions with real-world case studies

Students usually judge a topic as either comfortable or difficult based on the first few lessons they follow. They often find it interesting when the introductory lessons are coupled with real-world case studies or examples. This will enhance their understanding of LP concepts such as objective function, maximization/minimization, and constraints.

2. Searching LP problems on their own

Students' motivation to learn LP can be further boosted by directing them with proper guidelines to find practical LP problems on their own, as an individual or group activity. This method will help them identify the diversity of LPPs across various fields, structural changes in 2D, 3D, and 4D problems, and constraint diversity. Additionally, they will learn the differences between maximization and minimization problems. Sharing problems from the best collection of such LPPs with students enables them to learn from varied examples and enhance their skills.

3. Using LPP collected by students for assessments

The pool of best LP problems collected in the above step, which are not shared with the students, can be used for their assessments with proper alterations. This will increase student engagement and active learning, provide peer learning opportunities, and make assessments more meaningful. Further, they might feel a sense of ownership over their learning.

4. Design assessments for the steps of LP

Assessments can be designed to focus on the main steps of LP and to achieve lesson learning outcomes. A few such assessment tasks are stated below:

(i) Formulate the given problem/case study/situation as a Linear Programming Problem.
(ii) Use the simplex method to obtain the optimum solution.
(iii) Perform the sensitivity analysis.

This approach is helpful with targeted skill evaluation, better alignment with learning outcomes, a structured learning process, and enhanced conceptual understanding.

Computer tools for classroom teaching

Lessons can be made simpler, more convenient, and interactive with computer solutions. In the case of LPPs, several tools are available for this purpose. For example, GeoGebra graphing calculator, Excel Solver and OpenSolver are recommended for beginners, while MATLAB / Octave and LINDO/LINGO are suitable for intermediate learners. Additionally, Python (PuLP) and AMPL are recommended for advanced modelling.

Using computer solutions for LPPs in classroom teaching offers educational, cognitive, and practical benefits. This enhances conceptual understanding, saves time while reducing calculation errors, facilitates real-world applications and promotes higher-order thinking with interactive learning. A brief introduction to a few such tools is given below.

GeoGebra Graphing Calculator

GeoGebra is a free and interactive tool (https://www.geogebra.org/graphing?lang=en), available both as a web-based platform and a mobile application, that can be used to visualize 2-variable LPPs. Since it is capable of graphing feasible regions and optimal solutions dynamically, this tool is also useful in teaching graphical methods.

Excel Solver and OpenSolver

Excel Solver and OpenSolver are add-ins to spreadsheet software. Excel Solver works with Microsoft Excel, while OpenSolver (https://opensolver.org/) is available for Google Sheets as well.

Both tools are especially well-suited for teaching LPPs in classrooms due to the several user-friendly features available. Many researchers have identified key advantages of using Solver with LP and used it effectively for their practical applications (Saleh & Latif, 2008).

1. Familiar Interface (Excel Environment)
Many students and teachers are already familiar with Excel/Sheets, and the add-in option can be used to install the Solver function. Solver is easy to learn compared to programming tools like Python or advanced solvers like LINGO. A clear spreadsheet layout of Solver makes it easy to model decision variables, constraints, and the objective function. It demonstrates a step-by-step approach for constructing LPP models. Figure 1 shows the solver interface for an LPP on Data Backup Scheduling.

DATA BACKUP SCHEDULING						
Input data:						
	x1	x2	x3			
	Backup 1	Backup 2	Backup 3	Total		Limits
Objective	2	3	4	46		
Back up 1 time requirement	1	0	0	4	>=	4
Back up 2 time requirement	0	1	0	6	>=	6
Back up 3 time requirement	0	0	1	5	>=	5
Total number of operations	1	1	1	15	<=	24
	>=	>=	>=			
Output results						
	x1	x2	x3	z		
Solution	4	6	5	46		

Figure 1: Solver interface for LPP

2. Quick Feedback and No Programming Required
Solver provides instant results, including the optimal solution, the objective function value, and the sensitivity report (for deeper analysis). Students can conveniently experiment by changing a cell or the constraints. Unlike Python (PuLP) or MATLAB, Excel Solver does not require coding, making optimization accessible to a wider audience.

3. Widely Available and Free
Excel Solver is built into the latest versions of Microsoft Excel, while OpenSolver is a free, open-source add-in that surpasses the capabilities of Excel Solver in solving large and more complex models. The licensing cost of MS Excel is minimal compared to MATLAB or LINDO.

4. Encourages Practical Application
It helps students connect classroom learning to real-world decision-making tools. The convenience of documenting each step of the solution process within the same file enables students to submit a single spreadsheet that contains the model, data, and results. Thus, it is highly suitable for assessments and presentations.

5. Generate reports
When solving LPPs with the simplex method, Solver generates 3 reports: Answer report, Sensitivity Report and Limit Report . This places it among the best tools for teaching and visualizing sensitivity concepts in introductory Linear Programming (LP) courses. It includes the decision variable table and the constraints table with reduced costs, shadow prices, allowable feasibility and optimality ranges as shown in Figure 2.

- **Reduced Cost:** How much the objective coefficient must improve before a non-basic variable enters the solution.
- **Allowable optimality ranges:** Range within which the objective coefficient can change without changing the optimal solution.
- **Shadow Price:** How much the objective function would change per unit increase in the RHS of the constraint.
- **Allowable feasibility ranges:** How much you can change the constraint RHS before the shadow price changes.

Microsoft Excel 16.0 Sensitivity Report
Worksheet: [Book1]Sheet1
Report Created: 7/28/2025 3:46:53 PM

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B13	Solution x1	4	0	2	1E+30	2
C13	Solution x2	6	0	3	1E+30	3
D13	Solution x3	5	0	4	1E+30	4

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
E6	Back up 1 time requirement Total	4	2	4	9	4
E7	Back up 2 time requirement Total	6	3	6	9	6
E8	Back up 3 time requirement Total	5	4	5	9	5
E9	Total number of operations Total	15	0	24	1E+30	9

Figure 2 : Sensitivity Report for Data Backup Scheduling

Concluding Remarks

Linear Programming is a foundational tool for solving optimization problems across diverse disciplines, yet it often presents learning challenges due to its abstract formulation and mathematical rigour. By integrating interactive activities and leveraging accessible technologies such as Excel Solver and OpenSolver, educators can bridge the gap between theoretical concepts and real-world applications. These tools not only simplify complex ideas but also empower students to visualize, explore, and internalize LP principles more effectively.

The approach of engaging students in case-based learning, collaborative problem sourcing, and step-wise assessments reinforces active participation and deeper understanding. When supported by iterative feedback and practical tools, learners are more likely to grasp LP concepts confidently and apply them meaningfully.

Ultimately, blending traditional instruction with hands-on technological tools cultivates a richer, student centered learning experience. It prepares students not only to solve textbook problems, but to apply optimization in real life decision making fulfilling the true potential of Linear Programming education.

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Why become an Actuary?

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Who is an Actuary?
The Institute and Faculty of Actuaries, UK, explains what an Actuary is in the following manner:
"Actuaries are problem solvers and strategic thinkers who use their mathematical skills to help measure the probability and risk of future events. They use these skills to predict the financial impact of these events on a business and its clients.
Businesses and governments increasingly depend on the skills of actuaries and analysts to help them model and plan for the future. As the world changes at an increasingly rapid pace, risk management expertise can help businesses navigate this evolving landscape."

What do Actuaries do?
An Actuary is a professional who estimates the financial impact of future events for a company.
To arrive at the above, Actuaries analyze the past historical data. When analyzing data, we need to ensure that the data is suitable for the purpose and reasonably accurate. If not, the accuracy of the results is impacted. Hence, there is data preparation and judgment prior to analyzing the same.

Afterwards, using the above data, we would estimate the likelihood of such a future event and the damage/impact of such an event if it does occur. This will then help the company in question prepare for the future and plan its strategies accordingly. The above exercise will help with managing the risks a company will face as well.

Which Industries do Actuaries Work in?
Traditionally, actuaries worked in the insurance sector. Still, the main sector actuaries work in is life and general (non-life) insurance companies. Here, we would estimate the policy liability of the insurance company, which will be the amount that they need to set aside now to pay future claims and meet the expenses related to the policies they have already sold. In addition, we will determine the premium rates to charge for the insurance covers provided to policyholders (customers).
The opportunities available to actuaries have expanded over time, particularly in countries such as UK, USA, Australia, etc. Actuaries now work in Banking & Finance, Pension Schemes, Technology Companies, Healthcare Industry, Governments, and even in other companies for a Risk Management or Investment role.
In Sri Lanka, at present, actuaries only work in the insurance sector, mainly in the life segment. Hopefully, as the number of actuaries grows, the opportunities also will increase to make full use of the actuarial skills.

Why should you become an Actuary?
This is a well-respected career path that you can consider following. The actuarial profession is highly paid, particularly in markets such as UK, USA, Australia, etc. The professional qualification that is issued by UK, USA, and Australia will open up the global job market for you, as there is a dearth of actuaries worldwide.
When I qualified as a Fellow of the Institute and Faculty of Actuaries, UK, in 2012, I became the only local with such a qualification working in Sri Lanka at that time. At present there are approximately 6 fellow actuaries in Sri Lanka with around 30 insurance companies in the country. The opportunities in Sri Lanka are expected to grow in the future as well.

Who can become an Actuary?
If you are good at mathematics / analytical subjects, this may be the career path for you. In order to pass the professional exams to become an Actuary, such skills are required. I believe that in addition to having the skill, you should also be committed and hard-working to complete the exams.
Later on, in your career as you hold more senior positions, you will need to work more closely with the management and other departments, and then you will need to have good communication and other soft skills to succeed in your job role.

How can you become an Actuary?
There are professional exams to pass to become an actuary. These exams, the ones that students usually follow in Sri Lanka, are those conducted by the UK, USA, Australian Institute of Actuaries. However, the Indian Actuarial Institute also conducts exams, which can be followed if desired. There are university degrees that give a certain level of exemptions from these professional exams, which can help you qualify faster.

What Study support is available in Sri Lanka?
Unfortunately, there are no structured exam preparation classes conducted in Sri Lanka. However, there are certain M.Sc. and B.Sc. programs that you can follow, which will cover the content necessary to get through some of the exams. Even a mathematics or statistics degree that you follow can help you gain an exemption or easily sit through exams relating to probability/statistics, financial mathematics, etc.

What Next?
Hope by now I have convinced you to follow an actuarial career path! If so, what next? Qualifying as a fellow actuary may take you 5-7 years. Hence, prior to going down this career path, it is recommended that you find out more to see if this is for you. I believe if you are good at math and you are genuinely interested in the field that you will stick to it.

Try it out!
Don't be nervous to commence the journey into Actuarial Science. Remember, it is somewhat difficult to qualify, but a possible goal to reach if you are good at math and are committed to the task at hand.

Decoding Consumer Preference with Choice-Based Conjoint: A Statistical Perspective

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As products and services become increasingly feature-rich and marketing becomes more personalized, understanding what truly matters to consumers is essential for success. Gaining insight into consumer preferences is a cornerstone of modern marketing, such as shaping strategies for pricing, product development, and market segmentation. Among various analytical methods, Choice-Based Conjoint (CBC) analysis stands out for its ability to model purchasing behavior through realistic trade-off scenarios. By combining techniques from experimental design, discrete choice modeling, and Bayesian statistics, CBC provides quantifiable insights into how consumers evaluate competing options and select the best suitable product/service features. This statistical approach enables businesses to simulate real-world decision-making processes, uncovering actionable data for optimizing product offerings and market positioning.

What is Choice-Based Conjoint (CBC)?

According to Sawtooth Software, a leading provider of conjoint analysis tools, “Choice-Based Conjoint” (CBC) is a technique for measuring preference and simulating market choices. Respondents are shown a series of choice tasks and asked to indicate which product they would choose (or none). Each product is described by a set of attributes with varying levels.”— Sawtooth Software Help Documentation.

Each choice task contributes data that helps estimate the part-worth utilities of each attribute level. These utilities quantify how much each feature influences preference.

These choice tasks closely mimic actual buying behavior, making CBC one of the most reliable methods for preference measurement and product optimization. It is widely used across industries from healthcare to consumer goods, banking to transportation, to answer questions:

- What price point is acceptable for a new feature?
- How much brand influence choice compared to functionality?
- Which product configuration will maximize market share?

Statistical Techniques in CBC

Experimental Design

Before data collection, a well-designed CBC study begins with an experimental design, which systematically combines attribute levels into choice tasks. To ensure the study is both statistically robust and manageable for respondents, CBC uses fractional factorial designs that reduce the total number of possible combinations into an efficient subset. Key design principles include:

- Orthogonality: attributes vary independently,
- Level balance: each level appears equally often, and
- Minimal overlap: levels are not repeated within a task.

These designs are often orthogonal and D-efficient, minimizing correlation between attributes and enabling precise estimation of part-worth utilities. Typically, each respondent evaluates 8–12 choice sets, each containing 3–4 product profiles, with an optional "none" choice to simulate realistic market conditions

Multinomial Logit Model (MNL)

The data collected in CBC studies is typically analyzed using the Multinomial Logit (MNL) model, which estimates the probability of each option being chosen based on the part-worth utilities of its attributes, helping to identify how different features influence consumer preference.

Hierarchical Bayesian Estimation (HB)

To refine consumer preference predictions at the individual level, CBC commonly employs Hierarchical Bayesian (HB) estimation, which combines each respondent's choice data with population-level information using Bayesian inference. This approach improves the accuracy of utility estimates by borrowing strength from the overall distribution, making HB the industry standard for its precision, flexibility, and ability to uncover market segmentation through personalized utility scores.

From Utilities to Market Insights

The estimated utilities from CBC studies serve as the foundation for market simulations, allowing researchers to predict how consumers might behave in real-world purchasing scenarios. These simulations support strategic decision-making by evaluating new product concepts, testing pricing strategies, and assessing potential cannibalization effects within a product line.
Additionally, the richness of CBC data enables the identification of preference-based segments using techniques such as Latent Class Analysis (LCA) or clustering methods like K-means and hierarchical clustering applied to individual-level utilities. These segmentation approaches use statistical criteria such as AIC or BIC to determine the optimal number of segments, providing deeper insights into distinct consumer groups and their preferences.

Real World Applications

Imagine a software development company working on a new ERP system with optional add-on functionalities. The development team wants to understand how customers value core features, deployment mode, platform compatibility, customization options, and monthly cost.

Attributes and Levels

Table 1 describes the tested attributes and their associated levels:

Table 1: Levels and attributes

	Attributes				
	Core Functions	**Deployment**	**Platform**	**Customization**	**Per User Monthly Cost**
Levels	Job Costing, Inventory	Cloud	Desktop	Yes	$50
	Job Costing, Inventory, Accounting	On-premise	Web	No	$70
	Full suite		Web and Mobile		$100

Each attribute reflects a real decision variable in the software development process:

- Core Functions: Modules included in the ERP system.
- Deployment: Whether the software is accessed via the cloud or installed locally.
- Platform: The type of devices supported by the system.
- Customization: The flexibility to adapt the software to business-specific workflows such as construction, manufacturing, hospitality, etc.
- Monthly Cost: The price charged per user per month.

Choice Tasks

Using the CBC methodology, each respondent was presented with 10–12 tasks, in which they selected their preferred product from a set of product profiles shown in each task. An example task is shown in Table 2.

Table 2: Example of Choice Task

Core Functions	Deployment	Platform	Customization	Per User Monthly Cost
Full suite	On-premise	Web	Yes	$70
Job Costing, Inventory, Accounting	Cloud	Desktop	No	$50
Full suite	Cloud	Web and Mobile	Yes	$100
None of these				

Importance of Attributes and Average Utility Values

As seen in Figure 1 (stacked bar), per-user monthly cost is the most influential attribute in respondents' decision-making, followed by Core Functions.

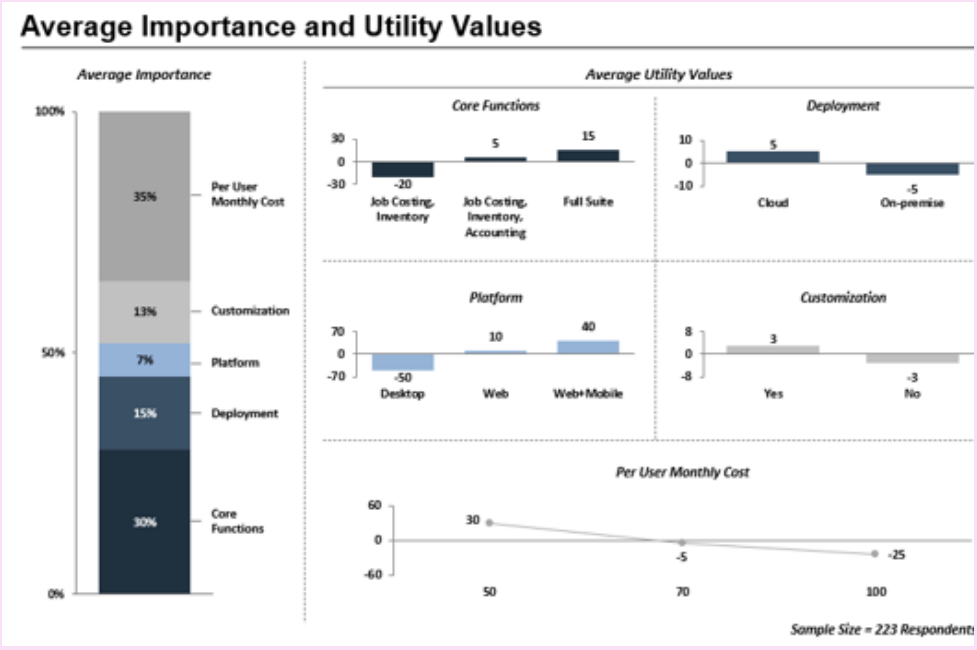

Figure 1: Importance of Attributes and Average Utility Values

Figure 1 breaks down average utility values for each attribute level. These values represent relative preference, centered around zero. Some key insights include:

- Full Suite functionality received the highest utility, indicating that users strongly prefer broader ERP solutions.
- There is strong price sensitivity: even a modest increase from $50 to $70 or $100 leads to a notable drop in preference.
- Cloud deployment and Web + Mobile access are preferred over older technologies like Desktop or On-premise options.

Market Share

Based on estimated utilities, market shares were simulated for various product profiles:

Table 3: Stimulated Market Share

Product	Core Functions	Deployment	Platform	Customization	Per User Monthly Cost	Market Share
Target product	Full suite	Cloud	Web and Mobile	Yes	$100	**34%**
Competitor 1	Full suite	Cloud	Web and Mobile	No	$100	**35%**
Competitor 2	Job Costing, Inventory, Accounting	Cloud	Web	No	$70	**14%**
No suitable products						**17%**

Table 3 shows that the target product has a projected market share of 34%, while a competing product with similar features but without customization slightly outperforms it at 35%. Another product with fewer features and a lower price captures 14% of the market. Additionally, 17% of respondents did not choose any of the listed products, indicating that a portion of the market remains unaddressed.

Final Thoughts

CBC analysis is a statistically rigorous and practically insightful method that blends experimental design, utility theory, and choice modeling to reveal what truly drives consumer decisions. Far more than just a marketing tool, CBC simulates real-world trade-offs to uncover actual choice behavior rather than stated preferences. CBC empowers businesses to make data-driven decisions on product design, pricing, and bundling strategies. For statisticians and analysts, CBC offers a rewarding avenue to apply quantitative skills in ways that directly influence market outcomes and business strategy.

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Statistical Solutions for Inflated Type 1 Error and Low Statistical Power Gene–Environment Interactions in Genetic Risk Prediction Models using "GxEprs"

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Introduction

Polygenic risk scores (PRS) have revolutionized genetic research, providing personalized predictions for diseases based on genetic profiles. A PRS aggregates the effects of numerous genetic variants (single nucleotide polymorphisms or SNPs) identified through genome-wide association studies (GWAS), facilitating predictions about complex traits such as obesity, diabetes, or heart disease.

In genetics, a phenotype refers to any observable characteristic or measurable trait of an individual, such as height, blood pressure, cholesterol level, or disease status. Phenotypes can be quantitative (continuous values like BMI or LDL cholesterol) or binary (discrete categories like presence or absence of diabetes). These traits are influenced not only by genetics but also by environmental exposures such as diet, lifestyle, and socioeconomic status.

However, genetic risks often do not act independently of environmental factors; rather, they interact, meaning that genetic susceptibility to certain conditions can be modified significantly by environmental conditions. This concept, known as genotype–environment (GxE) interaction, can profoundly influence the accuracy of PRS models. For example, an individual's genetic predisposition to obesity may manifest more strongly in those with low levels of physical activity.

Accurately modeling these interactions is challenging. Inaccurate GxE modeling can result in two primary statistical issues:

- Type 1 error inflation: mistakenly identifying a GxE effect that does not truly exist.
- Power loss: failing to detect genuine GxE effects when they exist.

Our Study

In our recent publication (Jayasinghe et. al (2024)), we aimed to improve the accuracy and reliability of PRS models that incorporate GxE interactions. Using extensive simulations and real-world data from the UK Biobank, we compared existing GxE PRS models to our newly developed approaches.

Key Findings

New Robust Models

We proposed two new statistical models to better handle potential GxE interaction errors and reduce false-positive signals without statistical power loss.

Simulation Results

Simulations demonstrated that the proposed models significantly outperform existing models by controlling type 1 errors and enhancing statistical power. Particularly, the methods proved effective even in scenarios of complex interactions and potential model misspecifications.

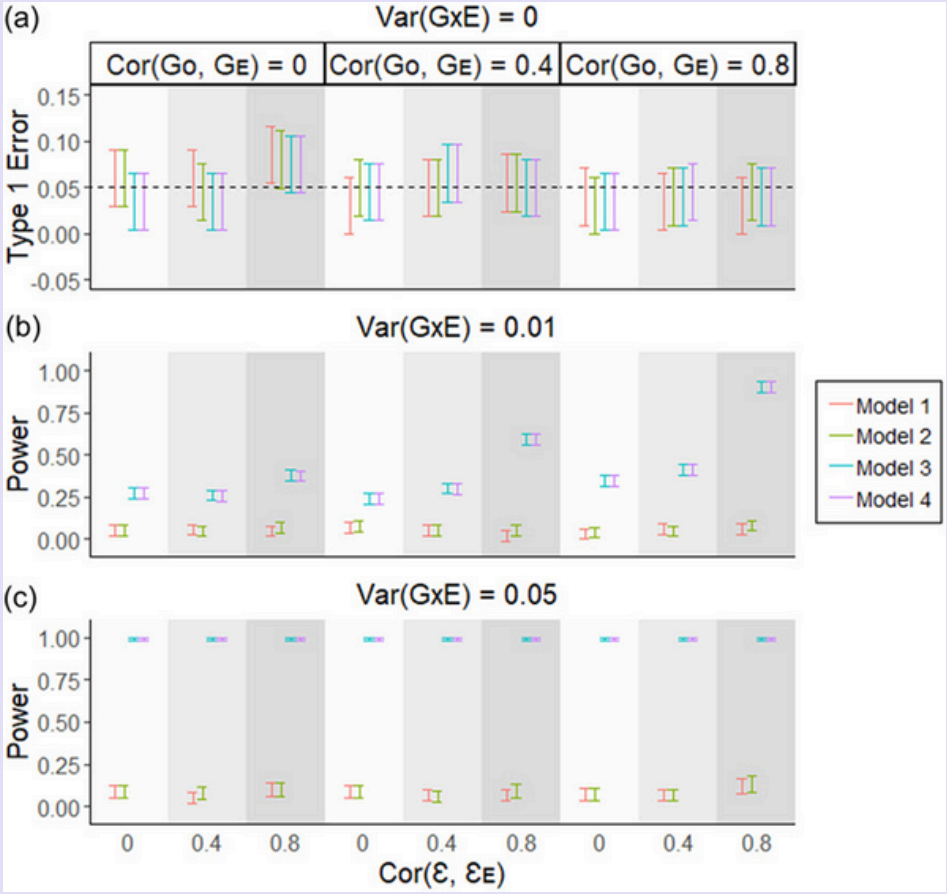

Figure 1: The type 1 error rate and statistical power of various GxE PRS models when using quantitative traits *(Source: Jayasinghe et. al (2024))*

For instance, Figure 1 summarizes the simulation results for quantitative traits, where different levels of genetic and residual correlations were examined. Models 1–3 represent existing genomic prediction approaches, while Model 4 is the new method proposed for quantitative traits in this study. Specifically, correlations between additive and environmental genetic effects (G_0,G_E) and residual effects (ε, ε_E) were set to 0, 0.4, and 0.8. SNP effects in the discovery dataset were estimated using standard GWAS and GWEIS equations. In simulations without GxE interaction (Var(GxE) = 0), all four models maintained a type 1 error rate of 5%. However, when GxE interactions were present (Var(GxE) = 0.01 or 0.05), Models 3 and 4 demonstrated higher power compared to Models 1 and 2. Models 3 and 4 showed comparable performance. For methodological details, see Jayasinghe et al. (2024).

Real-world Applications

Data source: Genotype data were sourced from the UK Biobank, a population-based cohort of over 500,000 individuals recruited across England, Scotland, and Wales between 2006 and 2010. Genotyping was conducted using the UK Biobank Axiom Array and imputed using the Haplotype Reference Consortium and UK10K+1000 Genomes reference panels. To reduce genetic heterogeneity, analyses were restricted to individuals of White British ancestry, the largest homogeneous subgroup.

We applied the proposed GxEprs models to real-world data from the UK Biobank. After comprehensive quality control (QC), we retained 288,792 White British individuals and 1,118,829 high-quality SNPs for analysis. QC steps included:

- **SNP-level filters:** imputation INFO score < 0.6, minor allele frequency (MAF) < 0.01, Hardy–Weinberg equilibrium p < 1e−7, call rate < 0.95, multiallelic variants, and duplicates were removed.
- **Individual-level filters:** non-European ancestry, sex mismatch, excessive missingness, aneuploidy, and genetic relatedness (GRM > 0.05) were excluded.
- Genotypes were standardized, and HapMap3 SNPs were used for stability in downstream PRS estimation.

The dataset was randomly divided into discovery (80%) and target (20%) sets. In the discovery set, GWAS and GxE GWAS (GWEIS) were conducted, and SNP effects were estimated. In the target set, we tested GxE PRS models.

Phenotypes included:
- **Quantitative traits:** BMI, waist-to-hip ratio (WHR), and LDL cholesterol.
- **Binary traits:** diabetes, hypertension, and coronary artery disease.

Environmental covariates included:
- For quantitative outcomes: alcohol consumption (ALC), healthy diet (HD), and physical activity (PA).
- For binary outcomes: BMI, HDL cholesterol, hemoglobin (HGB), and WHR.

Significant findings using our proposed GxE PRS models:
- Quantitative traits
  Genetic effects on BMI were significantly modulated by alcohol consumption frequency.
  Genetic effects on WHR were also modulated by alcohol intake, though just below the Bonferroni-adjusted significance threshold.
- Binary traits:
  Genetic susceptibility to hypertension was significantly modulated by WHR.

Software Availability

To facilitate the use of these improved models, we developed an easy-to-use R package named GxEprs, publicly available on GitHub as well as CRAN.
- GitHub page: https://github.com/DoviniJ/GxEprs
- CRAN page: https://cran.r-project.org/web/packages/GxEprs/index.html

Conclusion

Our study highlights the critical importance of accurately modeling genotype–environment interactions in genetic prediction models. The new GxE PRS models provide researchers with robust statistical tools, improving prediction accuracy and reducing false-positive findings. Such advancements pave the way toward more reliable personalized medicine and health risk assessments.

Collaborators

This study was a collaborative effort involving:
- Md. Moksedul Momin (UniSA and CVASU, Bangladesh)
- Kerri Beckmann (UniSA)
- Elina Hyppönen (UniSA)
- Beben Benyamin (UniSA)
- S. Hong Lee (UniSA)

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When Zero isn't an Option: Using Zero Truncated Negative Binomial Regression for Patient Visit Data

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1. History of the Zero-Truncated Negative Binomial Model

The first formal development of the truncated negative binomial distribution was introduced by Sampford (1955). He applied this distribution to biological data on chromosome break counts per cell in irradiated tissue. He showed how to fit a Negative Binomial model conditional on zero-truncated by method-of-moments and likelihood.

Later in that decade, Brass developed simplified fitting methods for the same model and applied them to demographic data about the number of children ever born to women (excluding childless women) (Brass, 1958). Brass explicitly cited Sampford's work and showed that the Negative Binomial fit is better than Poisson for over-dispersed (variance exceeds the mean) birth count data.

2. Rationale and Applications of the Zero-Truncated Negative Binomial Model

The Zero-Truncated Negative Binomial (ZTNB) model is a type of count regression. It is an extension of the Negative Binomial model, adjusted to account for the fact that zero counts are not possible or not recorded. Unlike Poisson or Standard Negative Binomial models, ZTNB excludes zeros and handles overdispersion.

Hospital count outcomes like length of stay or number of admissions per patient often cannot be zero and tend to be highly over-dispersed. In these situations, a ZTNB regression is appropriate.

Moreover, it provides a better fit for many real-world applications, such as criminology, the insurance industry, ecology, and marketing. In criminology, the ZTNB model is frequently applied to analyze criminal offense data where only offenders who have committed at least one crime are included. Furthermore, ecologists use ZTNB models when counting animal and plant species in field studies where only observed species are recorded.

3. Definition of the ZTNB Model

Consider a discrete random variable Y having a ZTNB distribution:

$$P(Y = y) = \left(\frac{y + k - 1}{y}\right)\frac{t^k(1-t)^y}{1 - t^k},$$

for $y = 1,2,3, \ldots$ where $t = \frac{\kappa}{k+\mu}$, μ is the mean of the negative binomial distribution, k is the dispersion parameter (also called the shape or size parameter), and y is a specific non-zero value of Y (i.e., y ≥ 1). The scale parameter accommodates extra variation so that the ZTNB distribution reduces to the truncated Poisson distribution in the limit $k \to \infty$.

The mean and variance of Y are,

$$E(Y) = \frac{\mu}{1 - t^k} \text{ and}$$

$$var(Y) = E(Y)\left(1 - \frac{\mu}{k} + \mu\right) - E(Y)^2, \quad \text{respectively.}$$

The link function in the ZTNB model is the logarithm (log) function. The formula is: $\ln(\boldsymbol{\mu}) = \boldsymbol{\eta}$ where $\boldsymbol{\eta}$ is the linear predictor. The linear predictor represents the linear combination of the predictor variables and their corresponding coefficients. The general form is:

$\boldsymbol{\eta} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p$, where β_0 is the intercept and $\beta_1, \beta_2, \ldots\ldots, \beta_p$ are the coefficients for the predictor variables $x_1, x_2, \ldots\ldots, x_p$

While the Standard Negative Binomial model is designed for over-dispersed count data where variance exceeds the mean, it assumes that zero counts are possible and present in the data. In contrast, the ZTNB model is specifically tailored for count data where zeros are structurally absent.
Compared to the Zero-Truncated Poisson model, which also handles zero-truncated data but assumes that the mean equals the dispersion, the ZTNB model introduces a dispersion parameter. It allows the model to account for the overdispersion more accurately.

4. Model implementation and interpretations

The ZTNB model is commonly implemented using specialized statistical software that can handle complex count data structures. In the R programming environment, the most widely used tool is the VGAM package, which provides the vglm() function for fitting a wide range of vector generalized linear models, including the ZTNB model.

Example:

Using a ZTNB model, researchers have identified several significant predictors influencing the length of stay among pediatric patients (Zulkifli et al., 2023; Lee et al., 2003).
The histogram shown in the following figure illustrates the distribution of patient visit days in Sirimavo Bandaranaike Specialized Children's Hospital (SBSCH) in Peradeniya, Sri Lanka, in 2023. According to the graph, the minimum hospitalized days for patients is one day.

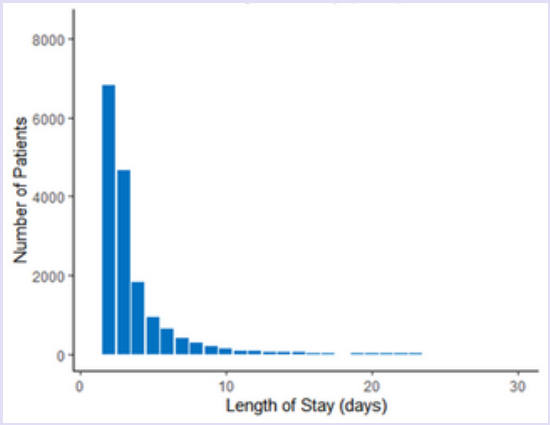

Figure 1: Distribution of Length of Stay

This dataset has been analyzed using a ZTNB model by considering factors such as the child's age, gender and the type of disease. According to the model outcomes, all age categories (preschooler, school-aged child, teen and toddler) are associated with a shorter LOS compared to the baby age group. Preschool children have 0.73 times as many hospital days as babies. Moreover, school-aged children and toddlers have approximately 0.80 times as many hospital days as babies. For example, if babies stay an average of 10 days, then toddlers and school-going children would stay around 8 days.Also, male children tend to have shorter hospital stays than females. Furthermore, patients with neoplasmic diseases expect to stay in the hospital for 1.8 days. Compared to those patients, children with chromosomal abnormalities have an expected length of stay that is over 4.3 times longer. For respiratory diseases, the length of stay is approximately 2.7 times longer compared to children diagnosed with neoplasms, which means an average stay of around 4.9 days. Similarly, those with circulatory disease are expected to have a hospital stay approximately 2.8 times longer than those with neoplasms.

To identify the best model for the count data, the ZTNB model was compared with the Zero-Truncated Poisson (ZTP) model. Unlike the standard poisson model, which includes the possibility of zero counts, the ZTP model adjusts the probability distribution to account for the absence of zeros. It assumes that the mean and variance of the data are equal, making it a simple choice for modeling truncated count data.

Using the Log-likelihood value, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), the best fitted model was selected .

Table 1: Performance of ZTP model

Goodness of fit test	ZTNB model	ZTP model
Log-likelihood	-44685.59	-54463.44
AIC	89417.19	108970.9
BIC	89603.94	109149.5

All AIC, BIC, and log-likelihood values confirmed that the ZTNB model provided a better fit than the ZTP model for this dataset.

5. Conclusion

The ZTNB regression model is used for count data with no zero values and where variance exceeds the mean. This model combines the negative binomial distribution with a truncation at zero. Therefore, it is a powerful tool for analyzing hospital length of stay (LOS) data, especially when zero counts are not possible and overdispersion is present. By accounting for both patient demographics and disease categories, the ZTNB model provides valuable insights into factors influencing hospitalization duration. These findings offer meaningful insights that can guide healthcare researchers and policymakers in making evidence-based decisions, improving resource allocation and shaping more effective healthcare strategies.

6. Challenges and limitations

The ZTNB model, while useful for modeling positive count data with over-dispersion, has several limitations. One major concern is zero-truncation bias, as the model only considers observations with counts greater than zero, potentially leading to selection bias and limiting the generalizability of results. Estimating the model can be computationally complex, especially for large datasets, due to the need to adjust the likelihood for missing zeros. While advanced statistical software like R offers support through packages like 'pscl', software limitations remain, especially for diagnostics and extensions.

7. Reference

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Spotlight on Statistical Pioneers

This Issue: Prof. Tim Swartz

Prof. Tim Swartz

Tim Swartz is a Professor in Statistics at Simon Fraser University (SFU), Canada. Renowned for his pioneering contributions to sports analytics, Bayesian computation, and statistical education, Prof. Swartz has made a profound global impact—particularly in Sri Lanka, where he has supervised five doctoral students. His election as a Fellow of the American Statistical Association (ASA) in 2019 recognized his "pioneering work in statistics in sport; significant contributions to Bayesian computation and applications; and service to the profession, including distance education and the development of statistics in Sri Lanka."

Rajitha Silva, on behalf of the Institute of Applied Statistics Sri Lanka (IASSL), had the opportunity to interview Prof. Swartz, during which he shared his academic journey, research insights, and advice for aspiring statisticians in Sri Lanka.

Rajitha: Thanks a lot, Tim, for agreeing to take part in this interview for the IASSL. Could you tell us about your academic path and what sparked your interest in statistics within sports?

Tim: Hello Rajitha, it is a pleasure to speak with you, and thank you for the opportunity to speak to the wider Sri Lankan Statistics audience.

Well, my academic journey has been a long one. It has been 40 years since I was appointed at Simon Fraser University (SFU). I feel that I have been lucky twice in my research. In the 1980s, I began work in Bayesian computation. This was an exciting time. Prior to that, I would describe the Bayesian approach as a curiosity. However, with the advent of new algorithms and personal computing, the major roadblock to Bayesian adoption (the approximation of high-dimensional integrals) was being overcome.

Many researchers flocked to this new area of research, where we found that challenging problems that had been faced in the past could now be practically addressed in a Bayesian setting. However, during that period and even before, I had this abiding interest in sport. These days, I continue to watch and play sports. I have even coached. In our department at SFU, we have an MSc program where students must complete a project. I found the project to be an excellent opportunity for my students to carry out sports research. My very first MSc student (Ser Hua Lee from Singapore) carried out an experiment in basketball where I attempted baskets from randomized locations on the court. We collected the data, and she fit models that examined my shooting proficiency. And then some of these projects turned into papers - in 1994, my student Wenjun Chen published the first (and maybe still the only) article on 5-pin bowling in The American Statistician.
Therefore, I began to see opportunities in sports analytics, and gradually my hobby of doing work in sports analytics became my primary research direction. It is appealing to me that there remain many open problems in sport for which it is possible to make meaningful contributions.

The “getting lucky” part of my research was that the Moneyball phenomenon, due to the Moneyball book (2003) and movie (2011) brought the attention of sports to a much wider audience. Suddenly, sports analytics became a hot topic. It also helped that the data landscape in sport was improving, and that journals became more open to sporting contributions.

So, that is where I sit today. I continue to carry out research in sports analytics. A new pursuit for me is writing sports books for a general audience. Last year, I completed the book “Pickleball Moneyball,” which speaks to the massively growing pickleball audience. And just recently, I have completed “Insights from Sports Analytics”, a book that discusses various topics in sports analytics. Both of these books are available from Amazon.

Rajitha: From pulling goalies in ice hockey to tactics in T20 Cricket—your research covers a wide range of sports. Can you describe some of the projects that excited you the most?

Tim: I tend to enjoy all of my research. It is a consequence of my belief that you do better work when you are highly interested in a topic. If the topic does not strike a fire in me, then I usually do not pursue it.

Related to your question, I would say it is not always easy to predict which of your papers will do well. For example, so many people have told me that they enjoyed and used my chatty 2020 article, “Where should I publish my sports paper?” which appeared in The American Statistician. There was nothing technical in this paper - just a bunch of counts and opinions. As another example, out of the blue, a few months ago, Nirodha Epasinghege Dona and I received an award for best paper of the year from the IMA Journal of Management Mathematics for our 2024 paper on optimal throw-ins in soccer.

Rajitha: Bayesian methods are central to your work. What do you think makes them particularly suited to this field?

Tim: I find the Bayesian paradigm appealing as it corresponds to the way that I process information. I walk around in life with an opinion on some topic (that is my prior). Then, I observe things that happen around me (that is my data). These observations then cause me to modify my opinion (the resulting belief is my posterior).

One of the things that makes sports research different from many other scientific application areas (e.g. genetics) is that we understand sport so well. We understand the objectives (e.g. score more goals than your opponent), we know the rules, and we have data which are typically accurate, plentiful and complete. This great understanding of sport assists us in modelling. It is modelling that perhaps distinguishes statisticians from data scientists that come from other disciplines. Why not take this great understanding that we have in sport and incorporate it in our modelling? Modelling is often facilitated by separating information that is contained in prior understanding and data.

Ultimately, in sport, we want conclusions that concern probabilities. And here, the Bayesian approach is well-suited. The posterior is a probability distribution which yields probabilistic conclusions. In sport, we also are frequently interested in forecasting. This too is well-suited to a Bayesian approach where the predictive distribution provides formal inferences. Given that you can obtain the posterior (even by sampling-based methods), the availability of the predictive is usually a straightforward extension.

Of course, there are often computational advantages of a Bayesian approach. For all of these reasons, I like to have the Bayesian toolkit nearby when doing sports analytics research.

Rajitha: As someone who has supervised multiple PhD students from Sri Lanka, how do you view the importance of international mentorship and collaboration in shaping the next generation of statisticians?

Tim: My view is that there are a lot of talented and energetic students in the world. However, they do not all have the same systems that will help them succeed. For example, students need to be able to have access to data, students need to be able to identify and work on good problems, students need time and financial support to allow them to focus on their research, students need mentors who can guide them through research, writing, the publication process, etc. Therefore, from a student's point of view, they need to be in the right place with the right support systems to help them succeed. Sometimes this can be done locally, but often, it helps to go away to the “best” situation. I get a lot of cold calls or emails where people want to collaborate with me. Although I appreciate the interest, I find that it is better to first have a personal relationship before embarking on research. This is why I emphasize “going away”. Only when you sit down with someone can you really get to know their strengths and how a project might develop.
So, my advice to students would be to go to a place that will allow you to do good work, wherever that may be. It is tough doing things completely on your own. If you can do good work, then the world opens up to you via potential experiences, the possibility of gaining employment and having a rewarding career and life. It also provides you with more options. Likely, international experiences expand those options.

Rajitha: Many undergraduates in Sri Lanka are curious about sports analytics. What new trends in sports data or analytics do you think students and educators should keep an eye on?

Tim: As I had mentioned, sports analytics remains “hot”, and it is more difficult to make contributions in well-studied areas. For example, you are not likely to make much of an impact with limited boxscore data when all of the North American teams and their analysts have access to extensive tracking data. I therefore think that less well-studied areas have greater opportunity. For example, I was watching television in Sri Lanka and was following the sport Kabaddi. I had never heard of Kabaddi, and I have certainly not seen a paper on Kabaddi. When you work with smaller sporting entities, they likely don't have the resources to carry out sports analytics research. Therefore, they may be very happy to share their data, tell you about their problems of interest and collaborate.

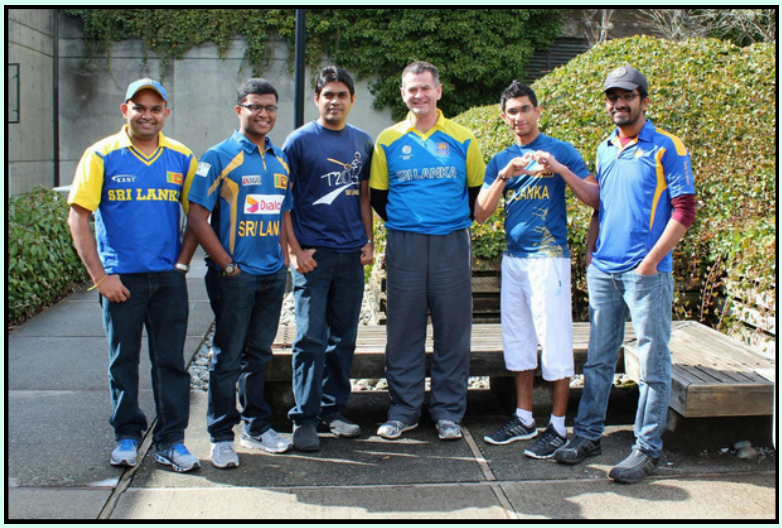
Now, of course, many Sri Lankans love cricket, and I have done a considerable amount of research in the sport. But my activity has slowed down, partly because I can read the writing on the walls. Tracking data is either coming or has arrived in cricket, and that will change the landscape of cricket analytics. When you have tracking data, it is spatio-temporal. You know the locations of all players measured as often as 10 times/second. This enables the investigation of problems that were previously unimaginable.

For example, optimal defensive alignment is something that has not been seriously investigated. If you can get your hands on cricket tracking data, then the world is your oyster.

Rajitha: You have attended almost every IASSL conference since 2004 and delivered the keynote address at the most recent meeting in December 2025 — highlighting your long-standing and unique connection with Sri Lanka. What new activities, collaborations, or visits do you have planned next to continue strengthening this bond?

Tim: Yes, the 2025 meeting was wonderful. I can't thank the organizers enough for putting on such a great meeting. And I loved our trip to Ella prior to the meeting.
I am unsure of the future. I would love to return to Sri Lanka - let's see. If I do, I want to have some good problems in my back pocket so that some collaboration can take place. At the moment, I am currently co-supervising two Sri Lankan students. Hashan Peiris is a PhD student, studying Actuarial Science. However, he loves sport and we have some side projects on the go. We have already published a paper in tennis (IJSS&C) that investigates unforced errors. Also, my MSc student Pavanthi Sudasinghe is doing sports analytics. Specifically, she is using tracking data in soccer to investigate pressing.

Rajitha: Thank you, Tim, for this inspiring and enriching conversation. Your long-standing engagement with Sri Lanka—through supervision, research, and continued presence at IASSL events—has not only elevated our academic community but also inspired many young statisticians to think ambitiously and globally. We are truly grateful for your contributions, and we look forward to seeing how your future work continues to shape the field.



IASSL Celebrates Academic Excellence at the Annual Convocation

The Institute of Applied Statistics Sri Lanka (IASSL) marked another milestone in statistical education with its prestigious awards ceremony held on July 27th, 2025, at the Lavender Room of the Bandaranaike Memorial International Conference Hall.

The ceremony honored the achievements of graduates from three key programs: third batch of the Higher Diploma in Applied Statistics, eleventh batch of the Diploma in Applied Statistics and the first batch of the Certificate in Applied Statistics programmes.

Professor R.O Thattil served as the Chief Guest for the occasion, lending his expertise and presence to celebrate the next generation of statistical professionals. The event brought together a distinguished gathering including members of IASSL's Executive Council, dedicated subcommittee members, the accomplished graduates, and their beaming families.

This year's graduating cohort represents a significant achievement in statistical education, with 13 students successfully completing the Higher Diploma in Applied Statistics program, 35 students earning their Diploma in Applied Statistics, and 9 students completing the Certificate in Applied Statistics.
This year, two Diploma students were also awarded scholarships in recognition of their academic excellence, further highlighting IASSL's support for outstanding learners.

The diverse range of programs reflects IASSL's commitment to providing comprehensive statistical education at multiple levels, from foundational concepts to advanced applications.

Certificate in Applied Statistics

Diploma in Applied Statistics

Higher Diploma in Applied Statistics

Snapshots of Success: IASSL Graduation Highlights

Beyond the Numbers: Student Journeys with IASSL

I first learned about the Diploma program at the Institute of Applied Statistics Sri Lanka (IASSL) just a day before the inauguration ceremony. Despite the short notice, the IASSL management team responded promptly and warmly welcomed me into the program. As a teacher specializing in Advanced Level Statistics, I found this an excellent opportunity to deepen my knowledge and enhance my teaching skills. The course offered me valuable insights into even the smallest details of statistics, filling gaps I didn't know I had. The lecturers were outstanding; clear, methodical, and highly knowledgeable. heir ability to explain complex concepts simply and engagingly made learning both effective and enjoyable. The lecturer panel, comprised of professionals from well-recognized universities with extensive experience, brought immense value to the program.

Although the entire program and examinations were conducted online, it was never a limitation. The expert guidance and well-structured assignments, along with mid-term examinations, created a rich and interactive learning environment. With dedication and the strong support of my lecturers, I was proud to achieve a Distinction Pass with a GPA of 3.96.

As the only professional body for statisticians in Sri Lanka, IASSL holds a highly respected reputation among the public. This recognition adds great value to the qualification. I wholeheartedly recommend the IASSL Diploma program to anyone who wishes to expand their statistical knowledge and gain a prestigious professional credential. It has been a truly rewarding and transformative journey.

K.S.P. Fonseka
Mathematics and Statistics tutor

As a naval officer in the rank of Commander, I had the privilege of successfully completing the Higher Diploma in Applied Statistics (Batch No. 3) at the Institute of Applied Statistics Sri Lanka (IASSL). This program was a truly enriching academic experience that significantly broadened my knowledge and skills in the field of statistics. The structured curriculum, which combined both theoretical foundations and practical applications, enabled me to better appreciate the importance of statistical reasoning in decision-making and problem-solving. Throughout the course, I was particularly impressed by the expertise and commitment of the lecturers, who not only delivered complex concepts in a clear manner but also encouraged critical thinking and practical engagement.

The exposure to modern statistical tools and techniques, coupled with hands-on assignments, enhanced my analytical abilities and gave me confidence in applying statistical methods to real-world scenarios.

From a professional standpoint, the knowledge I gained has been immensely valuable in my naval career. In an environment where data-driven insights are crucial for strategic planning, resource allocation, and operational efficiency, the ability to analyze and interpret data has given me an added advantage. Moreover, the program has strengthened my academic foundation, preparing me for further research and higher studies in applied statistics.

Overall, my experience with IASSL has been transformative. It not only enriched my academic journey but also added substantial value to my professional role as a naval officer, equipping me with the tools to make informed, evidence-based decisions.

K.A.D.P. Kodikara
RSP, psc, MSc(D & SS), PgDip(DM)
Commander (N) , Sri Lanka Navy

As a lecturer in Environmental Chemistry and Toxicology fields at a state university, conducting high-quality research and publishing in reputed, peer-reviewed, indexed journals requires not only strong subject knowledge but also advanced skills in statistical data analysis. Modern research demands the use of updated analytical software and programming tools to ensure accuracy, reliability, and meaningful interpretation of data.
Recognizing this need, I enrolled in the Applied Statistics program offered by the Institute of Applied Statistics, Sri Lanka (IASSL). The program provided me with comprehensive knowledge and hands-on experience in essential tools such as Python for statistical data analysis, R programming, and SPSS data analysis. These skills have significantly enhanced my ability to process complex datasets, apply appropriate statistical models, and generate robust research outcomes.

One of my primary goals was to refine my existing knowledge and establish a solid foundation for using advanced analytical software confidently. IASSL successfully fulfilled this expectation, providing a well-structured learning experience that combined theoretical concepts with practical application.
This program has been an invaluable opportunity for professionals like me to gain advanced skills under the guidance of a recognized professional body. I am confident that the knowledge acquired through IASSL will continue to support my research journey and contribute to achieving higher academic and professional goals. This program is truly a remarkable opportunity and a significant milestone for anyone passionate about conducting research in innovative and impactful ways.

Dr. Nalika Dayananda
(PhD in Environmental Chemistry,
BSc (Hons))

Coming from a background in Human Resource Development for my bachelor's degree, I've always had a strong interest in statistics and mathematics. This long-standing passion motivated me to explore a more technical path, and enrolling in the Diploma in Applied Statistics at the Institute of Applied Statistics Sri Lanka (IASSL) was one of the best decisions I've made for my professional growth.
From the very beginning, the program exceeded my expectations. The lecturers were outstanding clear, supportive, and deeply knowledgeable. Their ability to break down complex concepts and present them in a simple, engaging, and practical manner made the learning process both enjoyable and highly effective. Despite being conducted fully online, the course was structured in a way that maintained a strong sense of interaction and academic rigor through regular assignments, mid-term exams, and constant lecturer support.

Although the course and exams were fully online, the interactive assignments, mid-term evaluations, and regular guidance created a vibrant and effective learning experience. The lecturer panel, made up of top academics and professionals from reputed universities, added immense value to the program.
Thanks to this supportive learning environment, I was able to achieve a Distinction Pass with a GPA of 3.94. I'm also proud to have been selected for one of the IASSL scholarships, which further motivated me to strive for excellence.
As the only professional body for statisticians in Sri Lanka, IASSL carries a strong reputation. This qualification has strengthened my skills and opened new doors for future opportunities in data analysis and research.
I highly recommend the IASSL Diploma to anyone interested in gaining a strong foundation in statistics. It is, without a doubt, the best institute for statistics education in Sri Lanka.

Theshan Hewage
Undergraduate Student
Department of Public Administration
Uva Wellassa University

I'm excited to share my story as a recent graduate of the Higher Diploma in Applied Statistics program at the Institute of Applied Statistics, Sri Lanka (IASSL).

My passion for statistics has been a constant throughout my life, even though my career path led me to become a lecturer in finance. This passion was first sparked by IASSL itself when I won the National Statistics Olympiad back in 2014 during my A/Ls, a competition organized by IASSL. That achievement really solidified my love for the subject and put me on a path to want to learn more.

A decade later, it's incredibly fulfilling to have returned to IASSL to earn another qualification. The Higher Diploma program was an amazing journey, and the online weekend lectures were a perfect fit for a working professional like me, letting me earn an advanced qualification without disrupting my career. The comprehensive curriculum blended theory with practical, real-world applications, equipping me with a solid skill set.

The lecturers at IASSL are highly qualified and fully committed. They weren't just teachers; they were mentors who were genuinely invested in our success, creating an environment that encouraged us to think critically. Beyond academics, IASSL fostered a vibrant community of like-minded people, creating a supportive network where we could share ideas and grow together.

I'm incredibly grateful to IASSL for being a part of my journey. I've realized that the knowledge of statistics is not just for statisticians; it's a fundamental skill for anyone who wants to build a sustainable career in any field. It provides the base for future growth and data-driven decision-making. That's why I confidently recommend the IASSL program to everyone, regardless of their profession.

Ms. Hansini Palihawadana
(B.Sc., M.Sc., CIMA Passed Finalist)
Lecturer (Probationary)
Department of Finance, FMSC, USJ

I, Dr. WKT Dushmantha currently working as a Lecturer (Probationary) at the Department of Ayurveda Medicine and Indigenous Medicine, Faculty of Indigenous Medicine, University of Colombo, recently marked a significant milestone in my professional and academic journey by earning the Diploma in Applied Statistics (Distinction Pass) from the Institute of Applied Statistics, Sri Lanka (IASSL). As a one-year programmes, this diploma represents a substantial foundation in statistical theory and applications.

Throughout the year, I immersed myself in rigorous coursework, including Descriptive Statistics, Statistical Software, Parametric and Non-parametric Statistics etc. My dedication and academic precision allowed me to complete the diploma with distinction, positioning me to gain the knowledge and real-life experience in statistics which are essential to my academic life and field of research.

When I embarked on the program, I didn't just enroll in courses, I committed myself to a year-long academic adventure. The diploma spans a full academic year, broken into two semesters. As I progressed, I appreciated how this program mirrors Level 1 of a B.Sc. in Statistics. It provided a solid grounding in key areas like probability, descriptive statistics, statistical inference, and distribution theory, all essential for a robust foundation in applied statistics.

What resonates most with me is IASSL's purpose and ethos. IASSL's mission is to advance the discipline of applied statistics in Sri Lanka through research, training, education, and professional development. Being part of this institute has connected me to a broader professional community committed to excellence in statistical practice.

Now that I have earned the Diploma in Applied Statistics, looking ahead with enthusiasm about furthering my statistical expertise, enhancing my analytical skills, and contributing meaningfully to the advancement of statistical research and application in Sri Lanka. To anyone contemplating this path, I encourage you to invest in yourself through this programme. The learning, the connections, and the professional readiness it fosters are invaluable.

Dr. W.K.T. Dushmantha
Lecturer (Probationary)
Faculty of Indigenous Medicine
University of Colombo

Celebrating Achivements of IASSL Members

Emeritus Professor Promotion – Professor Marina Roshini Sooriyarachchi

Professor Marina Roshini Sooriyarachchi joined the permanent academic staff of the Department of Statistics, University of Colombo, in 1988. She pursued her M.Sc. in Biometry at the University of Reading, UK, and upon her return to Colombo served as an Assistant Lecturer (Probationary) for two years. She then returned to Reading to complete her Ph.D. in Applied Statistics.

Following the completion of her doctoral studies, she was appointed Senior Lecturer (Grade II), and subsequently promoted to Senior Lecturer (Grade I), Associate Professor, Professor, and finally Senior Professor, a position she held until her resignation in 2023.

Professor Sooriyarachchi has taught a wide range of courses, particularly to Special Degree students in Statistics, with Medical Statistics and Generalized Linear Models being among her favourites. She also made significant contributions to postgraduate programmes, teaching in the M.Sc. in Applied Statistics at both the University of Colombo and SJU, and supervising numerous M.Sc., M.Phil., and Ph.D. students. She served as the M.Sc. Coordinator for about five years and also functioned as Research Coordinator for several years.

Her research portfolio includes over 100 journal and conference publications, many of which have been in leading international outlets. She has been the recipient of six Presidential Awards, several international awards, and numerous travel grants. Within the Institute of Applied Statistics, Sri Lanka (IASSL), she has held key positions and received multiple recognitions.

Internationally, Professor Sooriyarachchi was appointed Senior Research Fellow at the University of Reading and later at the University of Liverpool, while also undertaking sabbaticals at Reading and the University of London. Her research has been supported by competitive grants, including those from the University of Colombo, the Wellcome Trust (UK), and Novartis Pharma (Switzerland).

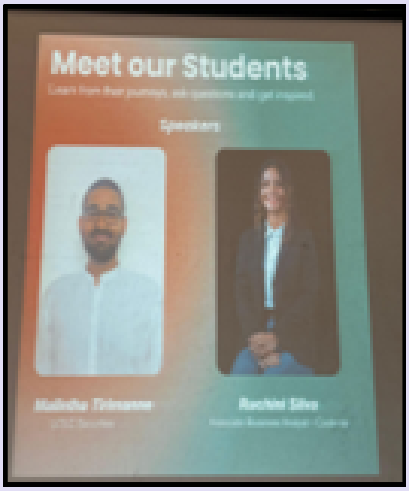
With this distinguished record of service, scholarship, and leadership, the conferment of the title of Emeritus Professor stands as a fitting recognition of her outstanding contributions to the advancement of statistics and higher education.

News & Events Spotlight:
Statistics/Data Science Departments and Student Societies

Highlights from Department of Statistics (DoS) and Statistics Society (SS), USJ

At the Department of Statistics, USJ, we have had an eventful and fulfilling few months from April to August 2025. It is our pleasure to share these memorable highlights with the distinguished readers of Issue 2, 2025 of the IASSL Newsletter. These events were organized in collaboration with the Statistics Society of USJ.

- **First Year Interactive Session at the Department of Statistics - 24 May, 2025**



The Department of Statistics organized an interactive session for our first-year students. This session provided a platform for newcomers to engage directly with our recent Statistics Special and Statistics Extended degree students, facilitating the exchange of experiences and insights. This was conducted by Mr. Malintha Tirimanne, a recent graduate of the Statistics Extended degree, and Ms. Ruchini Silva, a current undergraduate from the Statistics honours batch, to share their academic journeys and valuable perspectives.

- **Insightful Session by Milliman at the Department of Statistics - 27 May, 2025**

Milliman conducted an insightful session for Statistics and Mathematics honours degree students, introducing them to the world of actuarial science. It was an eye-opening session, especially as they explained how actuarial science connects with data science. That was a great opportunity for students with strong backgrounds in mathematics and statistics. This session was conducted by Mrs. Devindi Samaranayake, Mrs. Charlene Wijeyesinghe, Mr. Vipin Kumar, and the esteemed guest speakers from Milliman and hosted by the Department of Statistics.

- **Quora 3.0 - 12 June, 2025**

The Statistics Society of the University of Sri Jayewardenepura successfully held Quora 3.0, our annual quiz competition for freshers. The event aims to build leadership skills in the new Statistics special batch and foster friendships among first-year students. This year's Quora was extra special, with students from various combinations coming together in support. A heartfelt thank you to the lecturers and the organizing team for making it a great success!

- **Estadistica 2025- July 4, 2025**

The Statistics Society University of Sri Jayewardenepura proudly concluded Estadística 2025, our flagship event, Annual Statistics Day, with great success! This year was extra special as it marked the first in-person celebration since 2019. With the theme "Statistics to Success: Careers in a Data-Driven World," the day featured:

- A panel discussion with our own alumni in different domains, Mr. Sachin Kottearachchi, Mr. Kavindu Hapuarachchi, and Ms. Vanodya Perera moderated by Mrs. Rashmini Rathnaweera.
- A fun and engaging quiz session.
- An inspiring invited talk by Ms. Akshila Anurangi.
- Engaging musical session, which added energy to the day.
- Awards, tokens of appreciation of the DataXplore Datathon.

- **Special PhD recruitment talk - July 11, 2025**

The Department of Statistics, University of Sri Jayewardenepura hosted a special recruitment talk featuring Dr. Quan Long, Associate Professor at the Department of Biochemistry & Molecular Biology, Cumming School of Medicine, University of Calgary, who spoke on "**Representation Learning and Transfer Learning to Characterize Biology and Predict Diseases**" and Dr. Qingrun Zhang, Associate Professor at the Department of Mathematics & Statistics, Faculty of Science, University of Calgary, who presented on "**Stable and Interpretable Models and Tools for Small-Sample High-Dimensional Data Analysis in Biomedical Research**."

News & Events Spotlight:
Statistics/Data Science Departments and Student Societies

Highlights from Department of Statistics (DST) and Stat Circle of the University of Colombo

Where Knowledge Meets People Skills
The Stat Circle's Formula for Student Growth

The Stat Circle of the University of Colombo is the official student body of the Department of Statistics, that operates with the aim of enhancing the statistical knowledge of the students and outside community. We aspire to communicate and exchange various ideas and trends in the industry with other societies, universities and school children. By organizing a variety of events and sessions, the Stat Circle continues to create a platform where students can gain exposure to cutting-edge knowledge while also developing the soft skills required to thrive in today's evolving world.

In recent months, the Stat Circle was able to successfully organize sessions that together captured this vision-combining technical insight with career readiness. One such session conducted namely, "From Models to Meaning: Exploring Explainable AI", was conducted on the 13th of June at the Department of Statistics, and featured Mr. Dhanuskha Abeyrathne, Deputy General Manager of Data Analytics and Governance at MAS Holdings. Through his guest lecture, students were introduced to the rapidly evolving landscape of Artificial Intelligence, with a special focus on Explainable AI (XAI), which is an emerging field which has a plethora of applications. Using real-world examples, he illustrated how organizations across diverse industries leverage XAI, giving participants a rare opportunity to deepen their understanding of its practical value while also engaging in meaningful discussions and networking.

To complement this technical focus, we also focused on professional development through the workshop "Building a Winning CV: Career Readiness in Focus", held on the 27th of June via Zoom. Led by Mr. Israth Ali, a data scientist at John Keells Holdings PLC, the session offered students valuable insights into creating impactful CVs that stand out in a competitive job market. Participants not only learned how to structure and present their skills effectively but also gained direct exposure to industry expectations, with the chance to ask questions and receive tailored guidance.

Together, these sessions highlighted the mission of the Stat Circle: empowering students with both academic knowledge and the practical skills needed to navigate their future careers. The enthusiastic feedback from participants proved the value of such initiatives, and the Stat Circle is dedicated to continue this momentum, with our upcoming events as well; which include the Stat Day 2025, the 22nd edition of our flagship event which is scheduled to be held in October 2025, Merge Stat 4.0, an interschool statistics quiz competition which will be also held in October 2025, ML and AI Nexus, an inter-university quiz competition, as well as the Data Science Fair 2025, both of which will be held in parallel with the Stat Day 2025; all of which aim to foster knowledge sharing and networking among our community. We are truly excited and eagerly looking forward to these projects, confident that they will create even more opportunities for collaboration, learning, and growth.

Guest Talk on Conducting PhD Research and Writing the Thesis

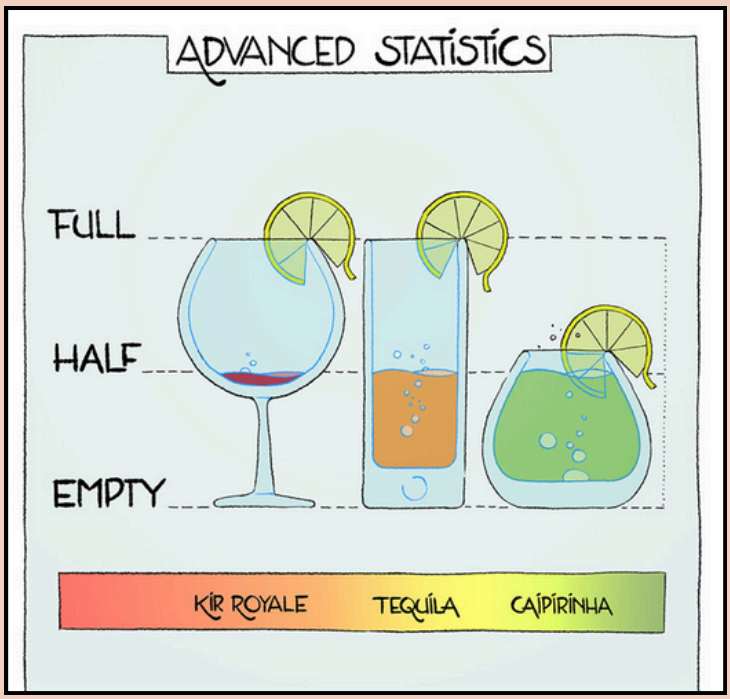
Prof. Amita Manatunga

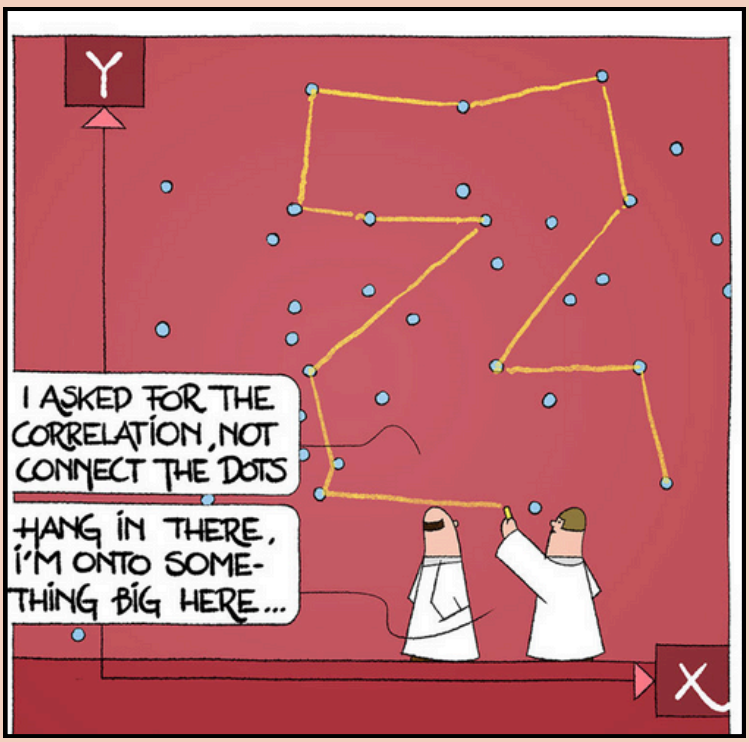
Prof. C. D. Tilakaratne from the Department of Statistics, University of Colombo, recently organized a guest lecture by Prof. Amita Manatunga from Emory University's Rollins School of Public Health on "Conducting PhD Research and Writing the Thesis" on July 11th, 2025, from 9:00 to 10:00 a.m. at the Statistics Conference Hall of the department. This lecture was buzzed with intellectual energy as academics and postgraduate students gathered for this special session. The event drew participants from multiple institutions, including the University of Colombo, University of Sri Jayewardenepura, University of Kelaniya, Kothalawala Defense University and alumni of those universities. Prof. Manatunga joined the session online, while the department offered both in-person and virtual attendance options, ensuring that geographical constraints wouldn't limit participation in this valuable learning opportunity.

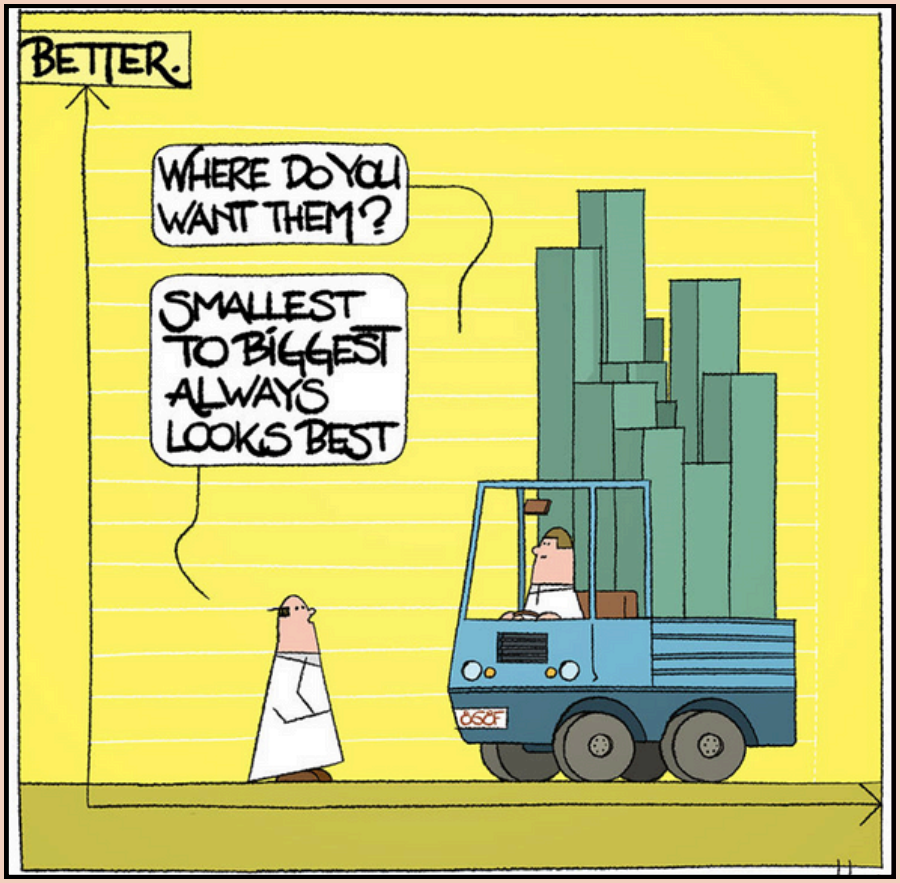
Prof. Manatunga brought her extensive experience to bear on the often-challenging journey of doctoral research. Her presentation covered the essential elements of successful PhD work, from the initial stages of research planning through the final thesis writing process. Drawing from years of mentoring doctoral students and conducting high-level research, she provided attendees with actionable strategies for navigating the complexities of advanced academic research. The session's interactive format allowed participants to engage directly with Prof. Manatunga through a comprehensive Q&A segment, where students and researchers received personalized guidance tailored to their specific academic challenges and research interests.

The Department of Statistics extends its heartfelt appreciation to Prof. Manatunga for generously sharing her expertise and time with our academic community. Equal gratitude goes to all participants whose thoughtful questions and active engagement made this session a truly enriching experience for everyone involved. Such collaborative efforts continue to strengthen the foundations of statistical research and education in Sri Lanka, creating pathways for academic excellence that will benefit future generations of researchers.

STAT COMICS







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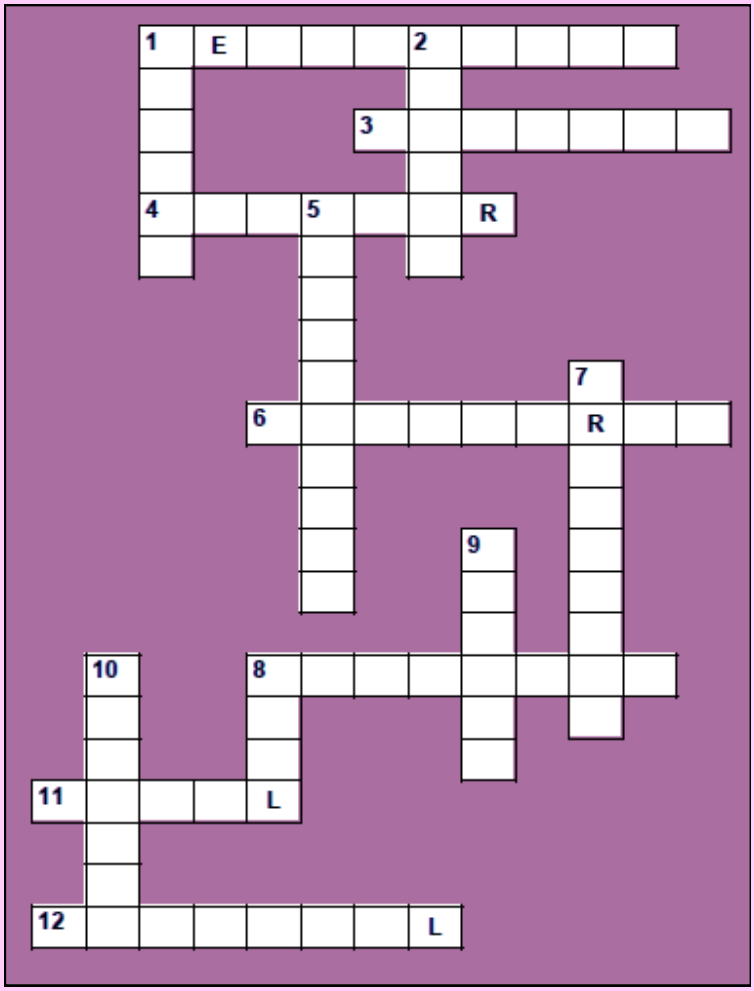
Puzzle Competition



Across

1. A type of statistical analysis involving dependent and independent variables
3. To guess what might happen next
4. The term for a data value that is significantly different from others
6. Frequency record built up in bars
8. The name of the probability distribution for the number of successes in a fixed number of trials
10. Statistician who introduced the correlation coefficient and chi-squared test
11. A single attempt in testing something
12. The scale of variables which measure with no true zero

Down

1. The type of sampling where every member has a chance to getting selected
2. Ask people questions to gather data
5. In statistics, this function measures the probability of observed data given certain parameter values.
7. Not following a consistent or predictable pattern in data.
8. The shape of a normal distribution curve
9. The distribution which is symmetric and unimodal

Please email your submission to appstatsl@gmail.com on or before 20th December 2025.
The draw will be held on the 28th December, 2025.

Correct submissions will be shortlisted and the winners will be selected randomly and will be announced in the Issue 3 of 2025 IASSL newsletter.

WINNERS FROM ISSUE 1, 2025

- Vanodya Perera
- Rajith Kalinda Amarasinghe
- Naethree Premnath

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Courses conducted by IASSL during MAY - AUG 2025

- Certificate course on Basic Statistics for Managers and Researchers - 33rd Batch
- Certificate Course on Systematic Literature Review (SLR) with Bibliometric Analysis: a way of manuscript writing with PRISMA - 10th and 11th Batch
- Certificate course on Essential Training in Learning R - 3rd Batch
- Certificate course on Essential Training in Data Analysis with IBM SPSS - 1st Batch
- Certificate course on Qualitative Data Analysis with NVIVO Software - 1st Batch
- Certificate course on R Essential Training in Data Analysis - 3rd Batch
- Certificate course on Research Methodology - 4th Batch

Upcoming Courses (SEP-DEC 2025)

- Certificate Course on Machine Learning with Python
- Certificate Course on Basic Statistics for Managers and Researchers
- Certificate Course on Structural Equation Modeling (SEM) with AMOS & SmartPLS
- Artificial Neural Networks with R
- Certificate Course on Systematic Literature Review (SLR) with Bibliometric Analysis: a way of manuscript writing with PRISMA
- Certificate course on Data Analysis using Power BI

New Life Members of IASSL

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- **Ms. W. A. D. S. Ishuwara**
- **Mr. S. Kapiluxsan**
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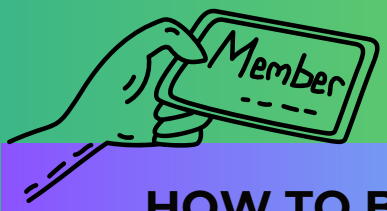

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IASSL Announces Flagship STAT ReTreat 2025: Connecting Minds, Building Statistical Futures

The Institute of Applied Statistics, Sri Lanka (IASSL) is proud to announce its inaugural flagship initiative, the IASSL STAT ReTreat 2025, a groundbreaking program designed to popularize statistics among young minds and empower the next generation of statistical thinkers and leaders. This first-ever retreat organized by IASSL is tentatively scheduled for October 17-19, 2025, at the National Institute of Co-operative Development (NICD Sri Lanka) in Polgolla, marking a historic milestone in the institute's commitment to fostering statistical excellence and building a vibrant community of data enthusiasts across Sri Lanka.

The retreat is specifically designed for undergraduate students pursuing bachelor's degrees with substantial statistical foundation. Through carefully crafted interactive sessions, engaging hands-on activities, and invaluable mentorship from leading professionals in the field, the retreat aims to ignite curiosity, build statistical confidence, and foster meaningful engagement with the discipline.

This comprehensive program represents IASSL's commitment to nurturing statistical talent and creating a supportive ecosystem for the next generation of data professionals who will shape Sri Lanka's statistical future.

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For the 11th time

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Organized by the Institute of Applied Statistics Sri Lanka, in collaboration with the University of Peradeniya

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Registration Deadline : 20th November 2025

More information
https://iassl.lk/national-statistics-olympiad-2025

Sri Lankan Journal of Applied Statistics (SLJAS)

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ABOUT SLJAS

SLJAS is an open-access, international, double-blind peer-reviewed journal published by the Institute of Applied Statistics, Sri Lanka (IASSL).

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Authors are warmly invited to submit their papers for publication in SLJAS

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Prof. Stanley Wijesundera Mawatha, Colombo 07, Sri Lanka.

The Institute of Applied Statistics, Sri Lanka (IASSL) was incorporated by the Parliament of Sri Lanka on 20th September 2011 under the Institute of Applied Statistics, Sri Lanka (Incorporation) Act No. 38 of 2011. It succeeds the former Applied Statistics Association, Sri Lanka (ASASL), established in 1999. IASSL is a proud member of the Organization of Professional Associations (OPA) of Sri Lanka.

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- At least 5 years of experience as a Statistician or in an equivalent position recognized by the IASSL Council.

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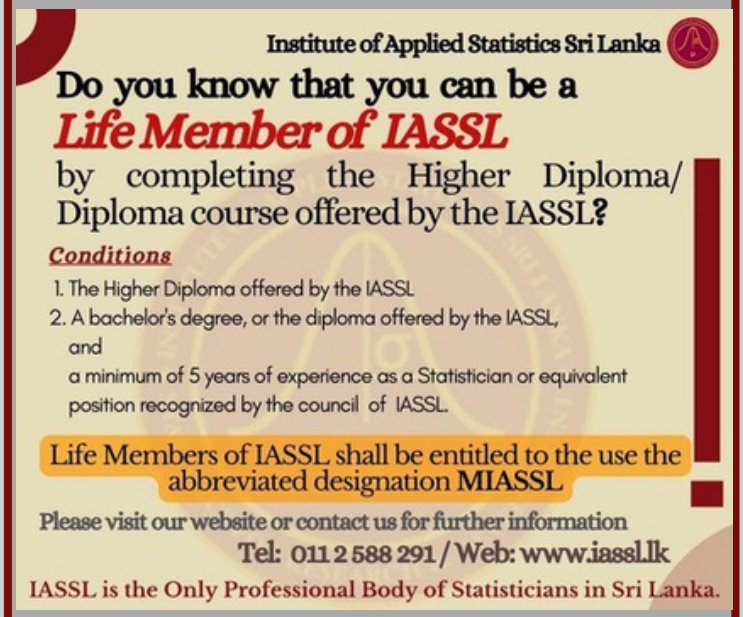

We are updating Contact Information of IASSL Members :

Please refer below link to update your details:
https://forms.gle/itfDcB5Buedbwp9F7

CONTRIBUTIONS TO THE SEP-DEC (ISSUE 3) 2025 NEWSLETTER:

If you have any submissions, comments, suggestions & or feedback, please send them to editor@iassl.lk.

WE SINCERELY APPRECIATE ALL WHO CONTRIBUTED TO THIS ISSUE, AND THOSE WHO PARTICIPATED IN THE PREPARATION OF IT.

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Official Newsletter of the Institute of Applied Statistics Sri Lanka

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