National Anthem

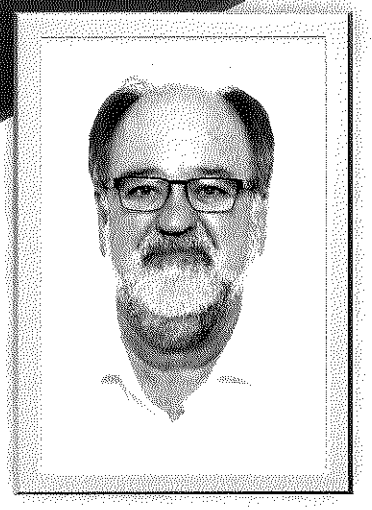
Nkosi sikelel' iAfrika
Maluphakanyisw' uphondo lwayo,
Yizwa imithandazo yethu,
Nkosi sikelela, thina lusapho lwayo.

Morena boloka setjhaba sa heso,
O fedise dintwa le matshwenyeho,
O se boloke, O se boloke setjhaba sa heso,
Setjhaba sa South Afrika – South Afrika.

Uit die blou van onse hemel,
Uit die diepte van ons see,
Oor ons ewige gebergtes,
Waar die kranse antwoord gee,

Sounds the call to come together,
And united we shall stand,
Let us live and strive for freedom,
In South Africa our land.

NWU®



Inaugural address

by

Prof. Philip Pretorius

7 June 2019
17:30 for 18:00

Big Lapa NWU Vanderbijlpark Campus

Faculty of Natural and Agricultural Sciences

North-West University Anthem

Bokone Bophirima	North-West
Re kaêlê Morêna	Guide us oh Lord
Ka wêna re ka êma	With you we can stand firm
Ra tshwarana	And be united
Ao, Morêna	Oh Lord
O re gôgê	Please guide us
Leseding re gôrôgê	So we reach where light is.
Waar die wilgers welig spruit,	Where willows grow abundantly
Doringboom sy skadu sprei,	Where thorn trees spread their shade
Soos ons groei in kundigheid	As we grow in knowledge
Mag U ons lei	May You give us guidance
Seën ons, o Heer	Bless us, Lord,
Lei met U hand	Guide with Your hand
Laat U seën rus oor ons land	Grant Your blessings o'er our land.
Three strong streams united flow	Three strong streams united flow
Africa stands proud and tall	Africa stands proud and tall
As we learn, we trust, we know	As we learn, we trust, we know
God is in control	God is in control
Bless us, oh Lord	Bless us, oh Lord
Guide us with grace	Guide us with grace
May North-West be blessed always	May North-West be blessed always
Bless us, oh Lord	Bless us oh Lord
Seën ons, o Heer	Bless us oh Lord
O re tshegofatse	Bless us
Morena	Lord
Seën ons	Bless us
Bless us, oh Lord	Bless us oh Lord

Lyrics: Theriso Tsambo (Tswana) / Corneels Schabort (Afrikaans, English)
Music: Katlego Maboe, Michael de Villiers, Stefan Pretorius, Niekie van der Walt, Johan Venter
Arrangement: Christa Steyn

Programme

Academic Procession

University Anthem

Scripture reading and prayer
Prof. Hans van Deventer

Word of welcome and Introduction
Prof. Eno Ebenso
Executive Dean, Faculty of Natural and Agricultural Sciences

Inaugural lecture
Operational Research: A better science for better decision making

Presentation of certificate and word of congratulations
Prof Refilwe Phaswana-Mafuya
Deputy Vice-Chancellor: Research and Innovation

Closing and table prayer
Prof. Hans van Deventer

National Anthem

Academic procession

Dinner

BIOGRAPHY

Prof. Philippus Daniël Pretorius was born in Rustenburg, and matriculated at Warm Bath High School in 1974 with four distinctions. He completed his BSc in Mathematical Statistics and Mathematical Economics (1977) and an honours degree with distinction in Probability Theory and Linear Programming (1979). He began his academic career as a junior researcher in the Department of Statistics and Operational Research at his alma mater, the Potchefstroom University of Christian Higher Education (now the North-West University).

In 1984, he returned to the NWU's Vaal Triangle Campus (VTC) as a lecturer, after working for Sanlam as actuarial clerk and senior investment clerk, and completed his Master of Science qualification in 1987 with distinction. During his time as lecturer at the VTC, he lectured Statistics and Operational Research on both undergraduate and postgraduate levels. In addition, he acted as a statistical consultant, not just for the campus management, staff, and students, but also for prominent figures from the industry, such as Ernst & Young, and the Auditor General.

Prof. Pretorius was promoted to senior lecturer and head of the Department of Statistics and Operational Research in 1999. In the same year, he completed his PhD with the title "Adaptive Summarizing Shewhart Control Charts" which addressed a persistent problem in both the literature and in industry in detecting permanent shifts, and ignoring temporary shifts in the process mean. As far as teaching is concerned, Prof. Pretorius was at the forefront when new modules were introduced at the VTC, for instance when the new degrees in Information Technology were introduced he undertook the teaching of the modules Decision Support Systems, Data Mining, and Understanding the World. Similarly, he taught the BMI modules (Business, Mathematics and Informatics), in addition to short courses in project management, quality and statistics. He was promoted to associate professor in 2007.

From 2008 to 2014, he was the director of the VTC's School of Information Technology, where he introduced extended programmes in the School of Information Technology. Under his directorship, the growth of the school was significant. He has received several awards for research, and has published at least 40 articles and papers and presented at approximately 30 national and international conferences. In his role as a supervisor, he has worked with three postdoctoral researchers; he has been the promoter of nine PhD students, and supervisor of 16 MSc students. His students have won local, national and international awards, both for research and for excellence in practice, for example, the SASOL DSS team was a finalist in the Franz Edelman awards in 2010.

Currently, Prof. Pretorius is involved with the School of Mathematical and Statistical Sciences (with links to the School of Computer and Information Sciences) in the Faculty of Natural and Agricultural Sciences at the North-West University. He is promoted to full professor in 2019. His focus is on better science for better decision making by using new data, new models and new frameworks in new or existing application areas.

Prof. Pretorius is supported by his wife of 36 years, Hendra, and their three children, Niël, Hedré and Jaco-Harm, along with his daughter-in-law Bonnie and two grandchildren, Daniël and Liné.

ABSTRACT

This article aims to illustrate better science for better decision making, using new data, new models and/or new frameworks. An operational researcher (OR) incorporates new data, new models and/or a new framework to improve decision making. My research focus is in the following fields: management of projects, operational research methodologies, statistics, experimentation, and simulation. The focus in the management of projects is project risk management. OR methodology focuses on developing a new framework. In turn, the focus in statistics is developing new risk models to improve understanding and performance. Experimentation involves the production of new data and simulation focuses on understanding and improving complex processes.

Subsequently, the challenges and future research in these fields are discussed.

Keywords: Operational Research, postgraduate studies, research frameworks, future research.

Operational Research:

A better science for better decision making

Prof Philip Pretorius

Operational Research (OR)

Examples

Research framework for OR

Conclusion

Operational Research

By 1939 the Royal Air Force commenced efforts to **extent the range of radar.**

Studies was done on the communication network and the people operating it.

The operators' techniques was **improved** and the limitations of network **revealed.**

(https://www.brittannica.com)

OR: Scientific approach

In **support of** high ranking officials in Britain,

scientists, engineers, mathematicians, actuaries, school teachers and lawyers

gather evidence to determine whether

tactics and practices need rethinking
(Thomas, W. 2019).

OR: Decision making process

Defining the problem

Search for alternative courses of action

Evaluation of alternatives

Selecting one **(or more)** alternative**(s)**

OR: Science of Better

(www.scienceofbetter.org)

Better for whom?

Optimize goals subject to constraints

- **Do best** under the constraints (efficient)

- **Change** constraints (effective)

Operational Research (OR)

The application of mathematical, statistical,

simulation and/or systems models that incorporate

probability, optimization and experimentation to

understand complex systems and

improve system performance

World War I (1914-1918)
Example (1917)

Reduce risk (probability that ship sink)

Risk depends on factors(Fleet sizes, Speed of travelling, Times of sailing)

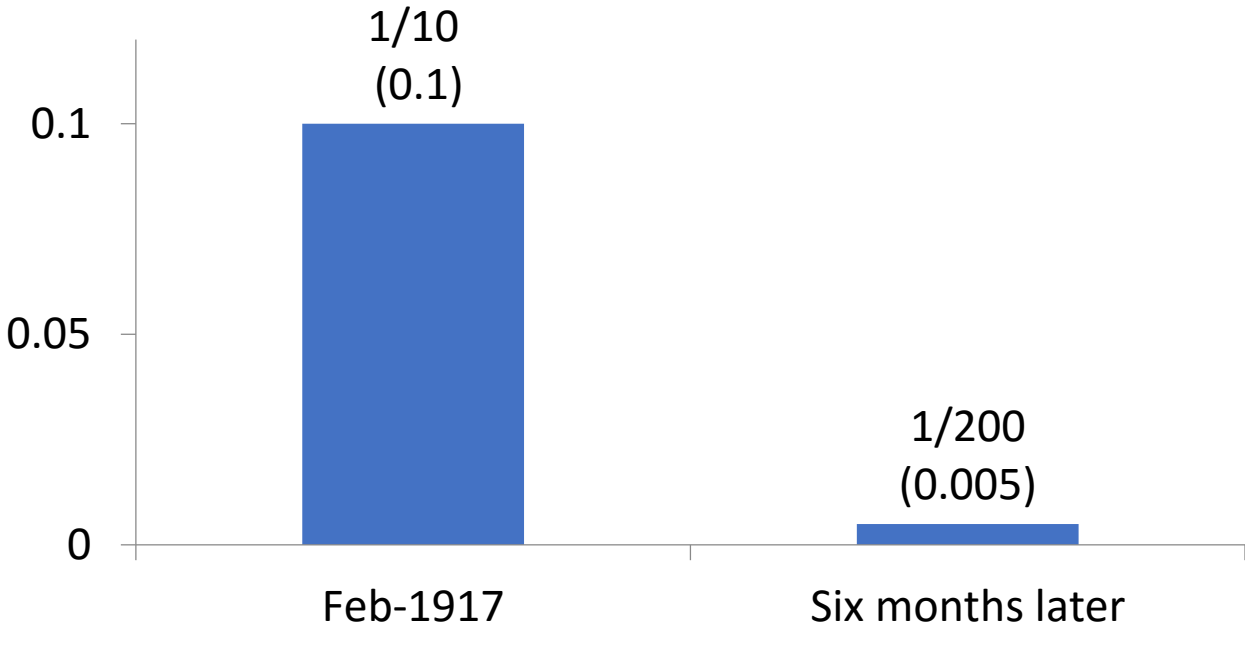
Evaluate risk for factor values

Make decision on factor values

(https://www.youtube.com/watch?v=ILWbaWrjgU4)

Risk of ships sinking in the Atlantic

(https://www.youtube.com/watch?v=ILWbaWrjgU4)



Everyday travel example

Modelling of
Risk, Travel time, Fuel consumption,….

Mathematical model (Time = Distance/Speed)

Statistical models (Averages, Probabilities)

Simulation models (Base Case, Scenarios)

Systems models (App, Google maps)

Everyday travel example

What is the weather and road conditions?

Are road assistance and protection available?

How does the traffic on different roads compare?

Did you pray before you travel?

My PhD research example

Standing literature and practical problem

Detect and estimate permanent level shifts

in the underlying process mean,

while temporary shifts (down fliers or up fliers)

may occur.

My PhD research example

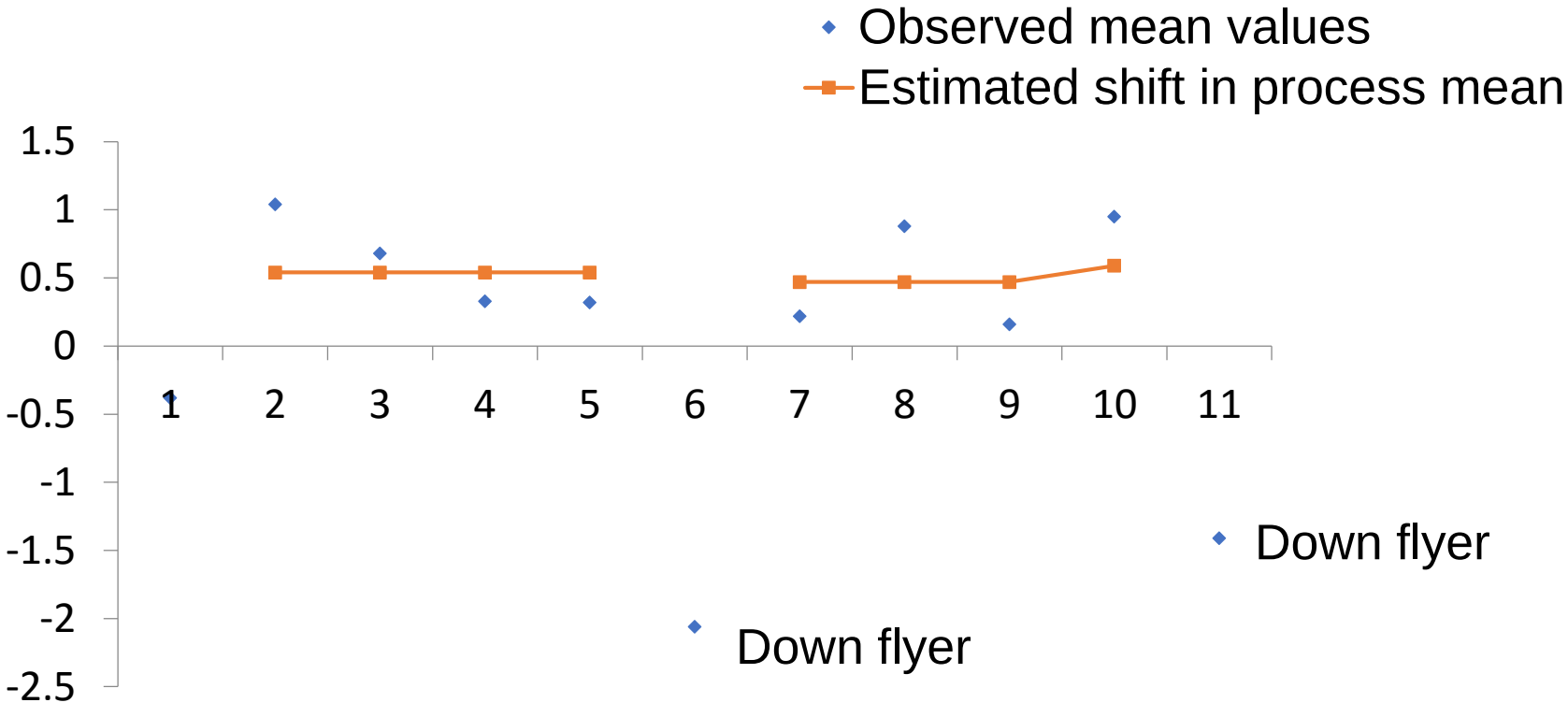
Mathematics (Calculus, Algebra)

Statistical model (Averages, Probabilities)

Simulation model (Base case, Scenarios)

Decision support model (ASUM Control chart)

Adaptive Summarizing (ASUM) chart
(Pretorius, P.D. 1999, p172-173)



Research framework for OR

Decision support models are developed

to be more effective and/or efficient for

Management of projects, OR methodologies,

Statistics, Experimentation and Simulation.

Management of project risks

Strategic, Project and Risk management

Project and Risk information

Risk studies
(De Villiers, D. 2003)

Management of project risks

Reducing failure of IT projects
(Bocibo, R.M. 2016)

Measuring success of IT projects
(Chele, M.E. 2017)

for financial accounting of small entities
(Möller, A. 2012)

OR research methodology

Formulation of a need as a problem

Search relevant resources for solutions and

translate it into specific solutions (**new models and/or new frameworks**)

Apply and evaluate solutions in terms of need

If solution not satisfactory, the process starts again(**re-search**),till satisfactory (operational) solution is found. (Pretorius, P.D., 1999, p17-p18)

OR modelling

Research start with

Standard methods and simple models,

moves to advanced methods and models, and

development of new models and/or combining models

while comparing the accuracy and validity of the models.

Comparing and using more models for better decision making.

New models
Combining

Time series and neural network models (Kruger, A.S., 2010)

Forecasting and volatility models (Fernandes, M.H., 2006)

Statistical and probability models (Pretorius, P.D., 1999)

Statistical and text mining models (Roberts, T., 2011)

New frameworks
Combining

Data Bases and Design of Experiments.
(Van Blerk, W.H., 2017)

Management of projects and Simulation.
(Meyer, M., 2005)

Simulation and Response Surface Optimization.
(Rossouw, R.F., 2009).

Simulation and Reliability, Availability and Maintenance.
(Van der Westhuizen, F.J. 2019)

Statistics

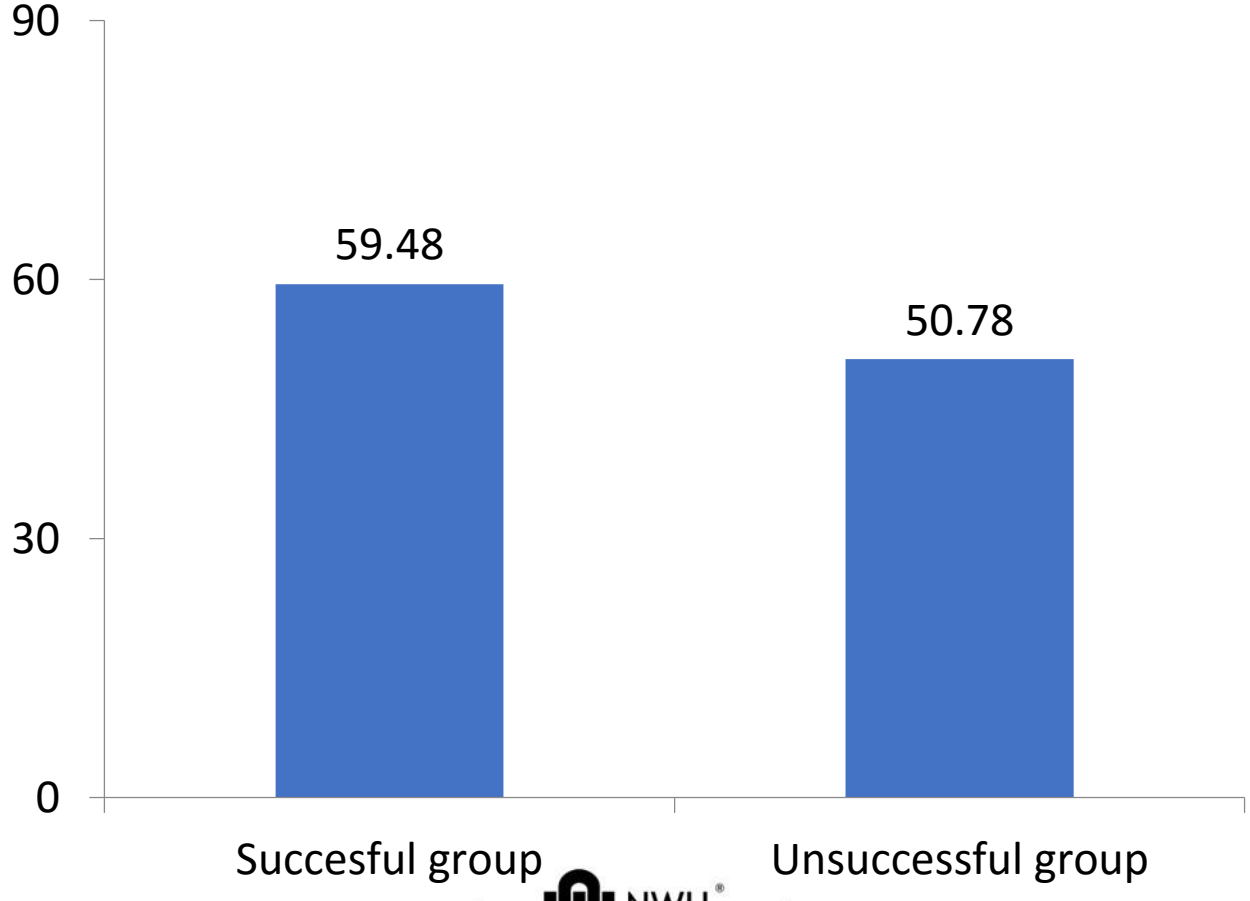
Psychology - Risk calculations for engineering students (Pretorius, A. 2004) - Illustrate parabolic fit and straight line fit

Health - Effects of demographic characteristics HIV prevalence over time (Sibanda, W. 2013, Dhlamini, M.G. 2018)

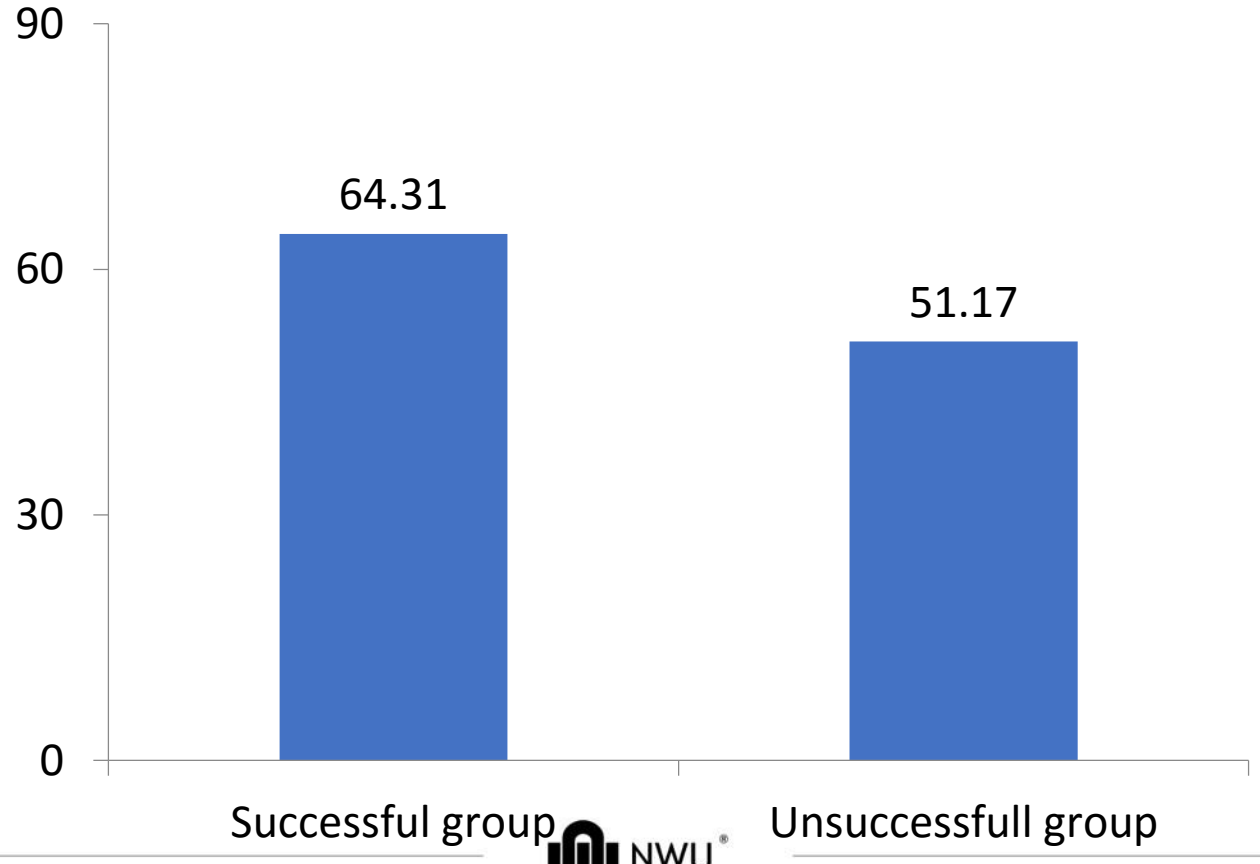
Law - Fraud risk factor identification and combination of several fraud risk scores (Roberts, T. 2013)

Investment - Investment strategies evaluated in terms of risk/reward and new risk measures developed (Groenewald, M.E. 2006)

Average mathematical anxiety of first year students, one sided p < 0.001
(Pretorius, A. 2014, p96)

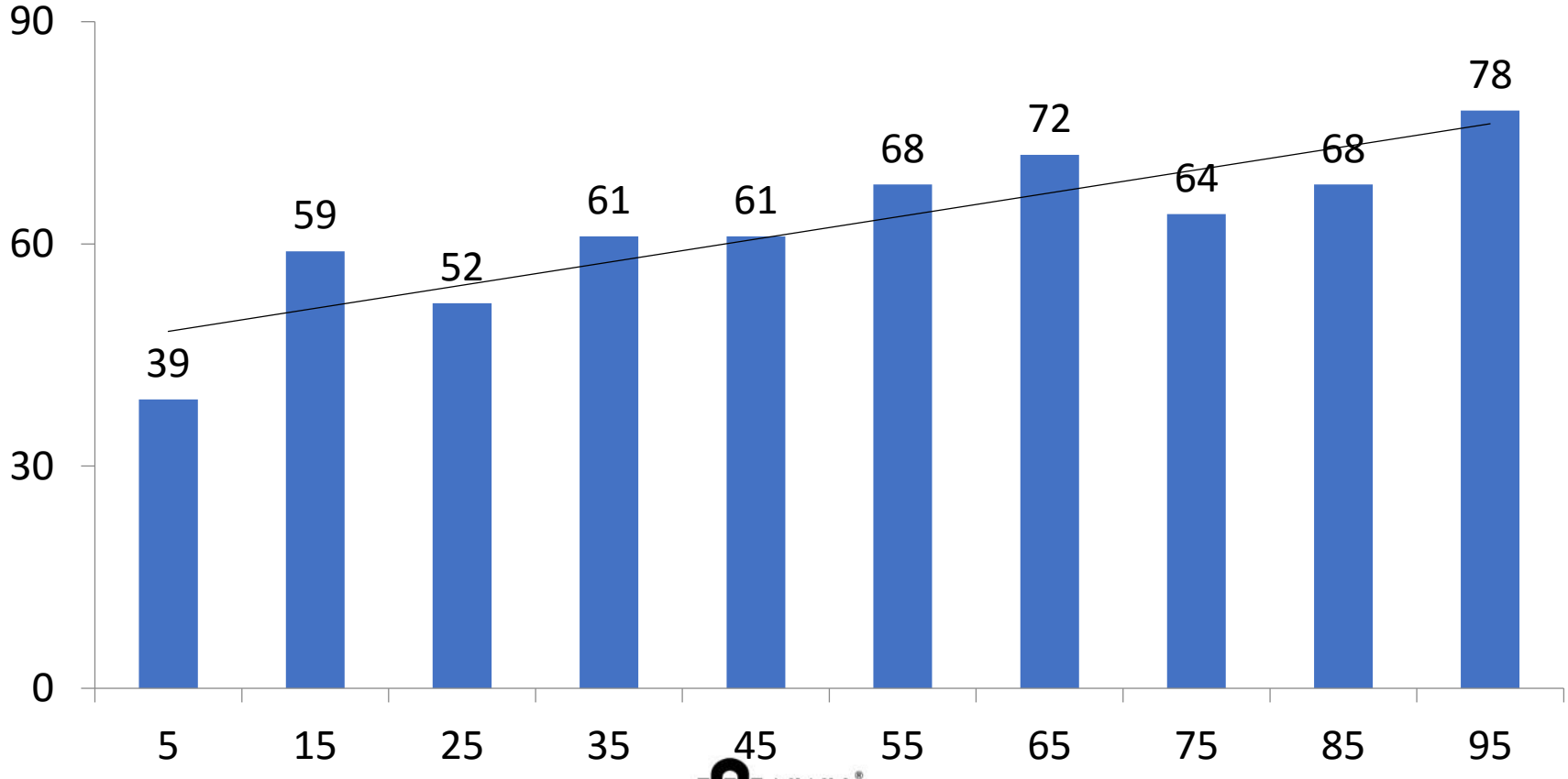


Average mathematical anxiety of senior students, one-sided p < 0.001
(Pretorius, A. 2014, p135)



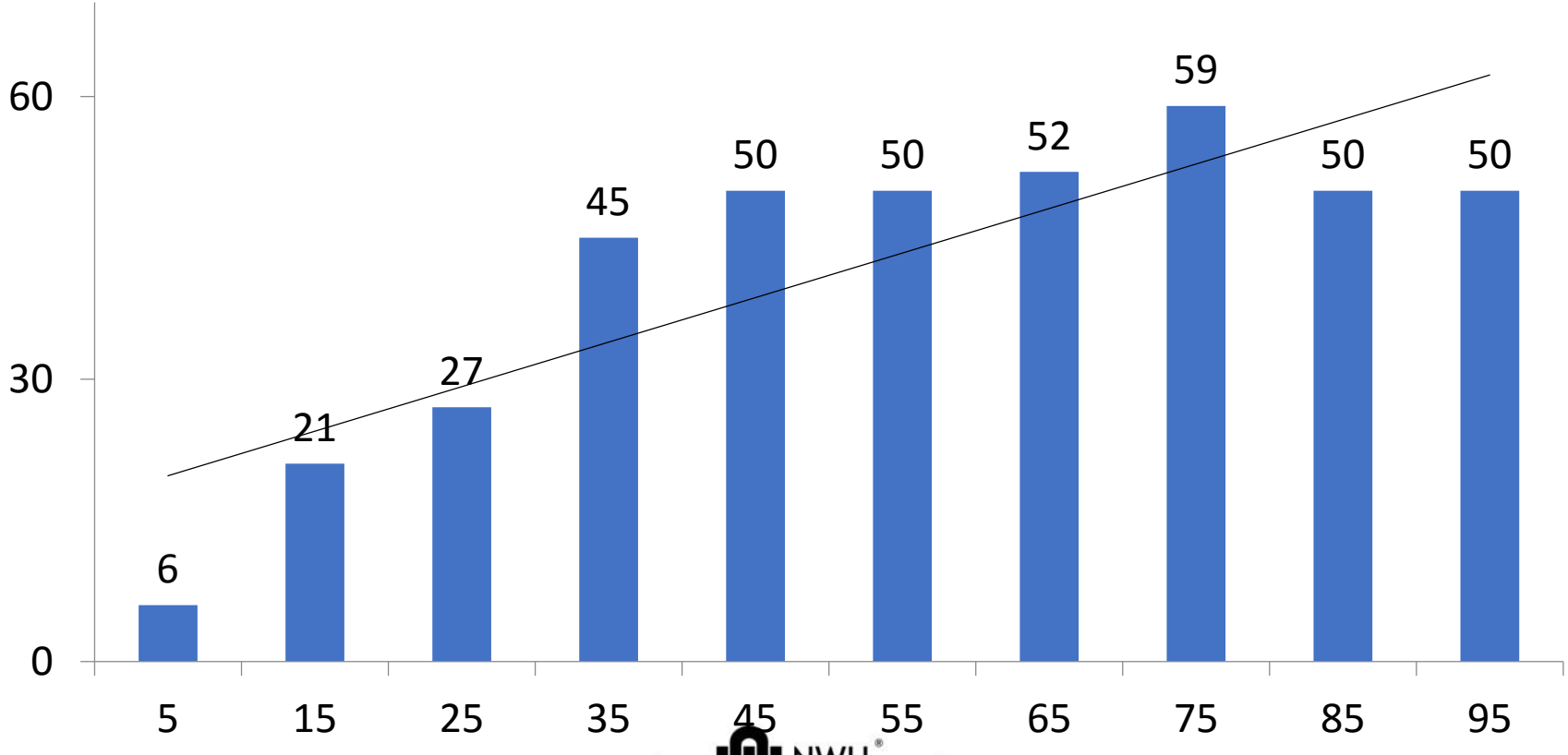
Observed chance of success (y) vs. Mathematical Anxiety(x) for first year students – straight line fit

(Pretorius, A. 2014, p99)



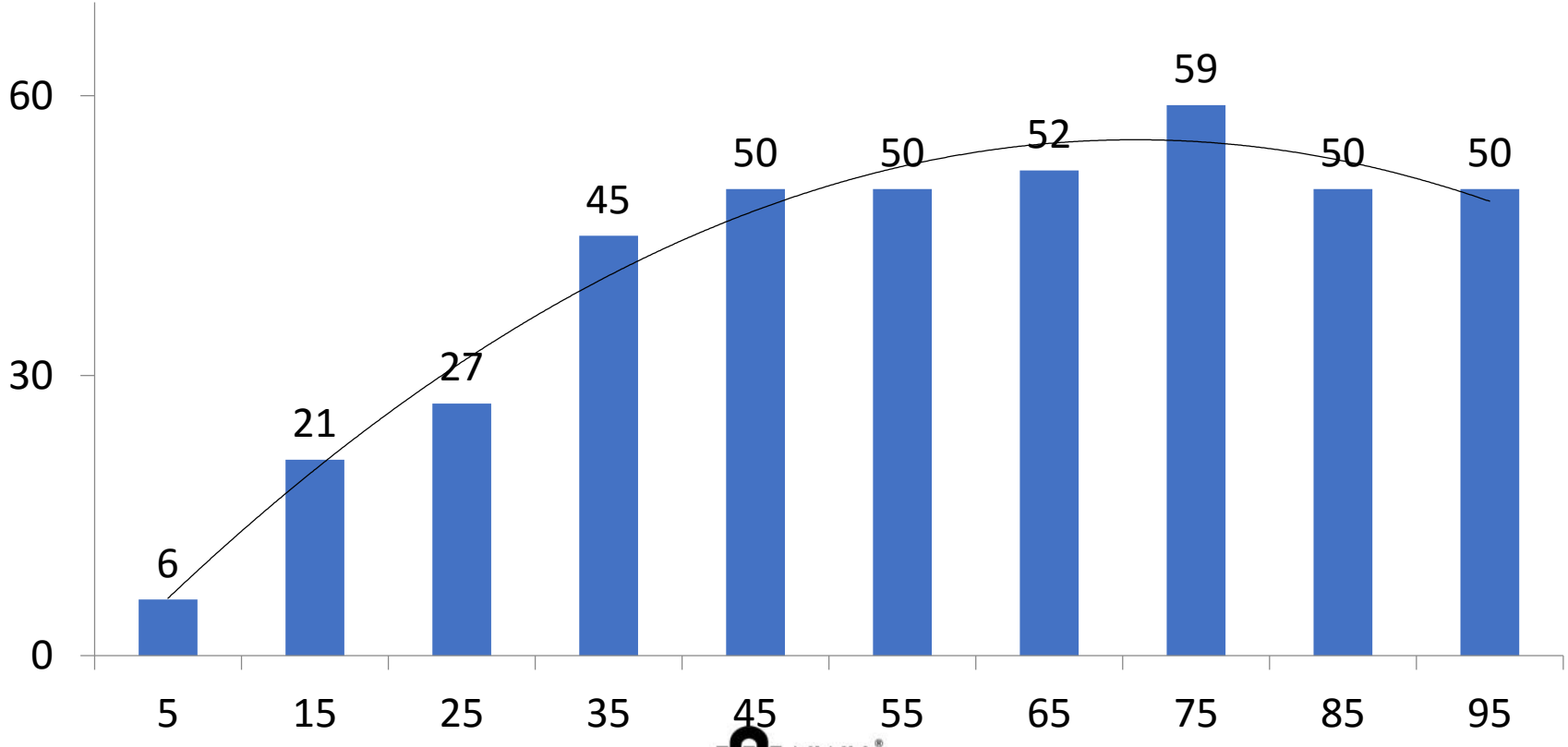
Observed chance of success (y) vs. Mathematical Anxiety(x) for senior students – straight line fit

(Pretorius, A. 2014, p139)



Observed chance of success (y) vs. Mathematical Anxiety(x) for senior students – parabolic curve

(Pretorius, A. 2004, p138)



Experiments

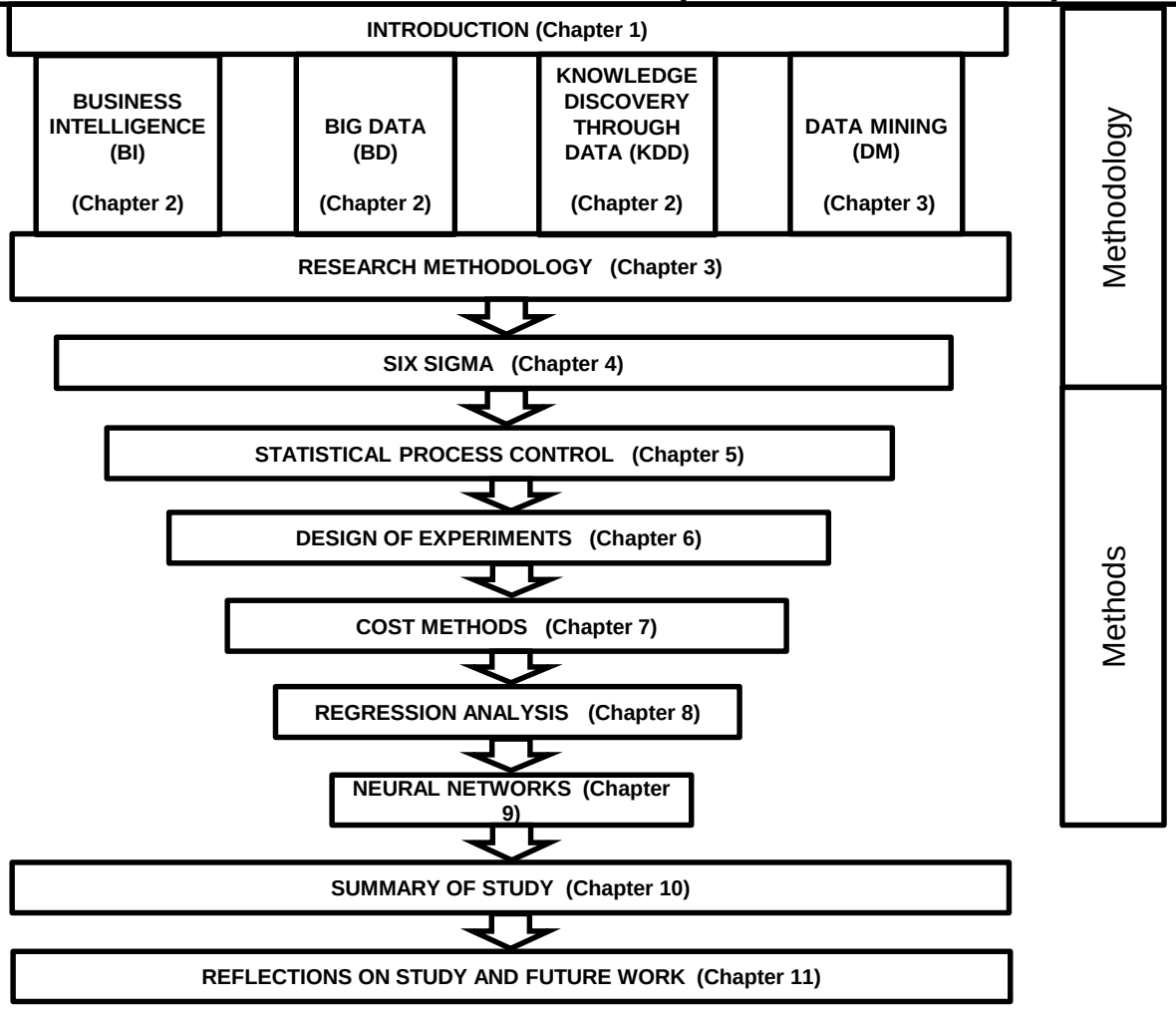
What can we learn from **available data**?

What is **missing** in the available data?

Experimentation is done to produce **new data for innovation**.

Design of Experiments is a way to model **interactions and nonlinearity** efficiently

A FRAMEWORK FOR ESTABLISHING AN EXPERIMENTAL DESIGN APPROACH IN INDUSTRIAL DATA MINING (Van Blerk, W.H. 2017)



Simulation

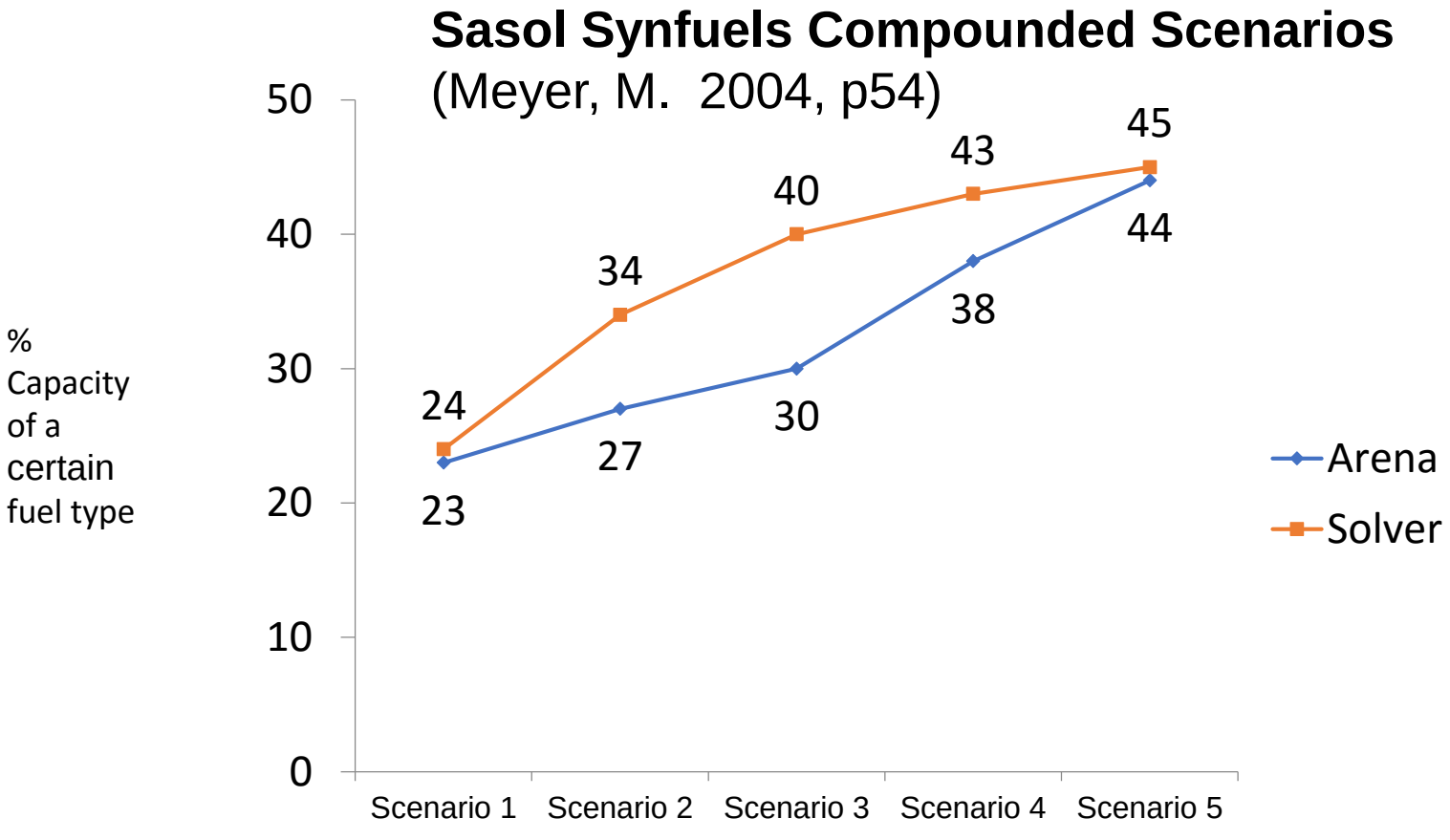
The scenarios where

mathematical optimization and

stochastic modeling converge are sustainable.

Where capital was required it could

now prove that it is necessary.
(Meyer, M. 2005, p54)


Sasol Synfuels Compounded Scenarios
(Meyer, M. 2004, p54)
% Capacity of a certain fuel type
50
40
30
20
10
0
24
34
40
43
45
23
27
30
38
44
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5
Arena
Solver

Research Framework for OR

Management of project risks
OR methodologies
Statistics
Experimentation
Simulation

Conclusion

Research framework for OR

take OR to the future.

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Thank you

Trust God,
Trust Father,
Trust Son and
Trust Holy Spirit