



What-if Scenarios: Bayesian network modelling for student success

UP and Wits Collaboration: Siyaphumelela Partners

29 June 2017




Introduction

- Siyaphumelela project has its focus on data analytics and informed decision-making
 - Five institutions
 - Autonomy on projects and evaluation
 - Feedback on projects
- Limited collaboration between the institutions



2



Student
Academic
Readiness
Survey

ORACLE[®]
BUSINESS INTELLIGENCE



power
HEDA
simplicity through innovation

Biographical
Questionnaire

HUGINEXPERT



3



Introduction

- Recipe for collaboration
 - Central venue
 - Good coffee
 - Food
 - Excited and interested staff
 - Captivating topic: data analytics



Introduction

22 March 2017 at Gordon Institute of Business Science

Presentation on **Bayesian models** by UP

- Objective: analyse student throughput, ask "What-if" questions with an expert knowledge system

Presentation on **Tableau BI system** by Wits

- Objective: to understand the individual student for support purposes



5



Introduction

- Institution to retain their data and de-identify student data
- Similar methodology, analytics, visualisations and data structures
- Task 1: Select variables
- Task 2: Review data structure
- Task 3: Priority to Bayesian models with Hugin Expert

30 May 2017: Training on Bayesian models

22 June 2017: Data analysis of Wits data



6



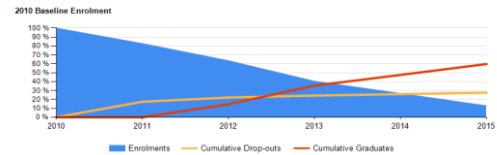
Part I

Leitlho

A Knowledge Base System for
Student Throughput Analysis

Descriptive Statistics

- Heda System



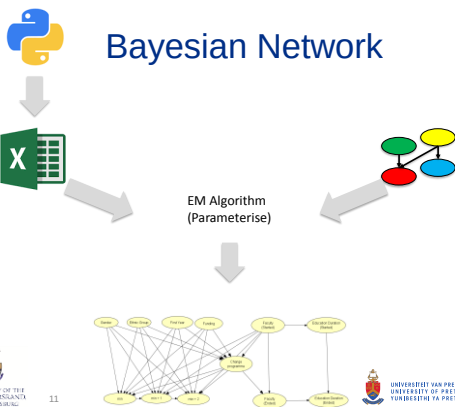
Alternative Approach

- **Knowledge base system (KBS)**
 - Knowledge base - contains information about the system
 - Inference engine - contains logical rules about the system
- **Main output**
 - Reason about the system
 - NB – in current state, it is not a predictive model

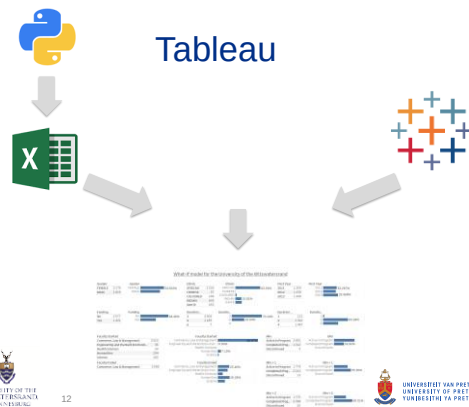


Process

- Pre-process data
- Parameterise model
 - Count frequencies of all configurations
 - Conditional probability table
- Software
 - Hugin (Educational licence)
 - **Tableau**



11



12



Bayesian Network

- Probabilistic
- Can handle
 - missing data
 - information other than data (expert knowledge)
- Can do predictive modelling
- Modular

Tableau

- Display frequencies and probabilities (%)
- Powerful visualisation
- Predictive Modelling



Variables

20 July 2017

Input

- Gender
- Ethnic Group
- First Year
- Funding
- Faculty (Started)
- Education Duration (Started)

Output

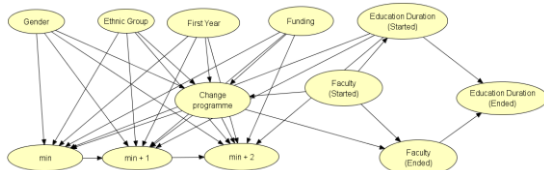
- Faculty (Ended)
- Education Duration (Ended)
- Change Programme
- Min
- Min + 1
- Min + 2

Assumptions

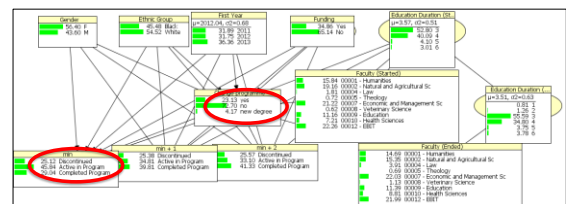
- First Year - Only first time entering students
- Funding – Indicates whether a student has funding or a sponsor for studies in the form of a loan or bursary. It does not relate to parents or guardian paying for student.



Bayesian Network



UP



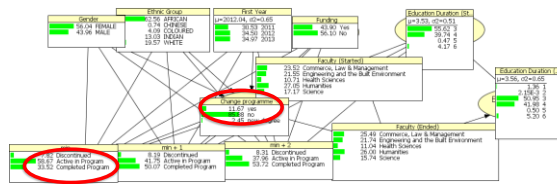
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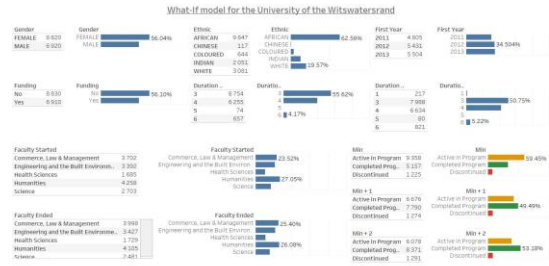
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Wits



Tableau



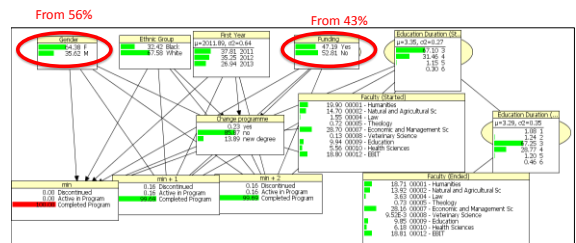
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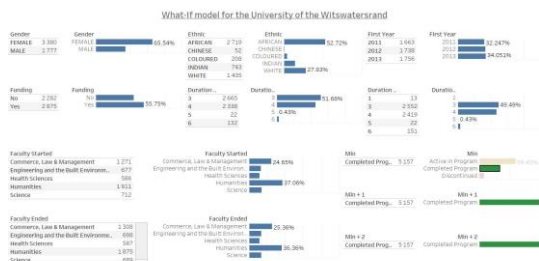
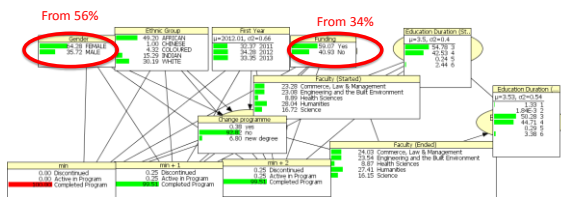
What-if Analysis

Best Case

UP



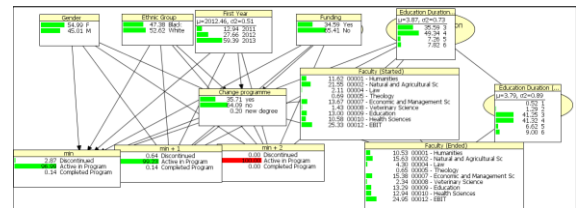
WITS



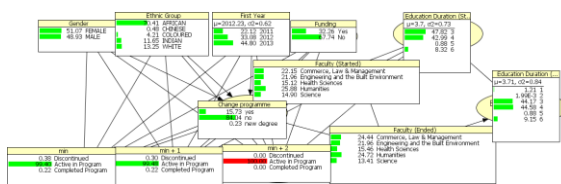
What-if Analysis

Worst Case

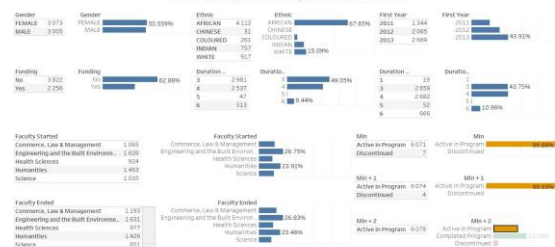
UP

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YUNIBESITHI YA PRETORIA

WITS



What-if model for the University of the Witwatersrand

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YUNIBESITHI YA PRETORIAUNIVERSITY OF THE
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JOHANNESBURGSiyaphumelela
we succeedUNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Advantages of collaboration

- Inter-institutional data dictionary
 - Standardise definitions and assumptions
- Understand differences (and similarities) between institutions
- Quality control of demographical data

The way forward
UP/Wits Collaboration

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Future Plans

- **Add variables**
 - School Quintiles; Language
 - Funding – more detail (type of funding, etc.)
 - 'Soft' data
 - Accommodation
 - First generation status
 - Rurality (Student Home Vs School)
 - Parent's income



31



Future Plans

- **Training on Tableau Model**
 - UP colleagues
 - Application of model to UP data (similar approach as Wits)
- **Development of Predictive Model(s)**
 - UP
 - Wits



32



Future Plans

- **Inclusion of UNIVEN (UP/Wits Collaboration)**
 - Bayesian & Tableau models
 - Predictive modelling
 - BQ data (2016 & 2017) collected so far
- **SAHELA Workshop (SAAR 2017)**
 - UP/Wits joint workshop
 - Sharing of results
 - Lessons learnt



33



Future Plans

- **Publishing of Results**
 - Research article(s) – peer-reviewed journal
- **Expansion of Scope of Collaboration**
 - Possible areas to collaborate



34



Wits/UP Co-Workers

Wits:

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Fezile Mdluli
Innocent Mamvura

UP:

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Alta De Waal
Wendy Kilfoil
Hugo Mouton



35

