Data Analytics for Business Decision Making
数据驱动下的商业决策分析

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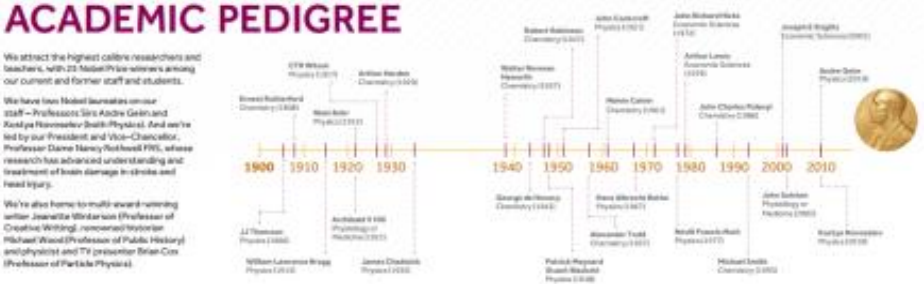
曼彻斯特大学 – The University of Manchester

“红砖”大学 - “Red brick” university



大学使命:

- World-class research,
- Outstanding learning and student experience,
- Social, economic and cultural impact.

曼彻斯特大学商学院 – Alliance Manchester Business School

- Alliance Manchester Business School (AMBS) 建于1965年，为英国最早的两所商学院之一。

个人简介

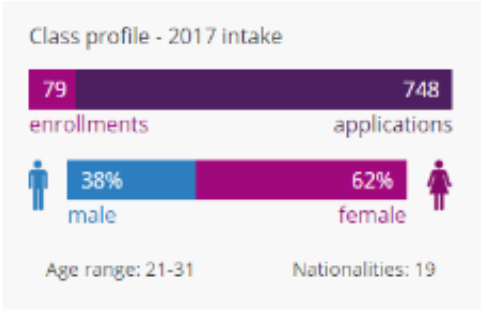
- 英国曼彻斯特大学决策科学高级讲师
- 上海交通大学控制科学与工程博士
- 曼彻斯特大学商学院商业分析硕士专业负责人
- 曼彻斯特大学数据科学硕士专业商业管理负责人

(QS Ranking: 6th in the world & 1st in Europe and in the UK)

UoM商业分析硕士专业

- MSc Business Analytics: Operational Research and Risk Analysis

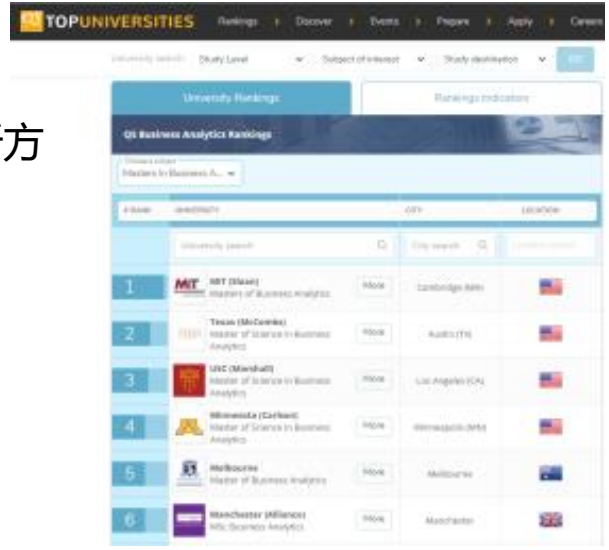
Semester 1	Semester 2	Summer
Core 1: Applied Statistics	Core 1: Risk, Performance and Decision Analysis	Dissertation *
Core 2: Mathematical Programming and Optimization	Core 2: Simulation and Risk Analysis	
Elective 1	Core 3: Data Analytics for Business Decision Making (SAS)	
Elective 2	Elective 1	



AON
BRITISH AIRWAYS
Unilever
THE OR SOCIETY
CGA
GENERAL MOTORS

UoM商业分析硕士专业 – Features and Facts

- 从传统运筹管理到商业分析和数据科学的转变。
- 重点培养学生应用定量方法(e.g., optimisation, statistics) 和数据分析方法 (e.g., simulation, decision and risk analysis, data analytics) 的技能。
- 使用专业软件分析工具，包括SAS, Risk Solver, Minitab, Simul8 , IDS。
- 优秀的UK PTES (Postgraduate Taught Experience Survey) 评价结果。
- QS世界大学商业分析硕士专业排名全球第六欧洲第一。



商业与数据分析 – Trend analysis

https://www.youtube.com/watch?v=9hDnO_ykC7Y

Top 5 analytics predictions for 2015

- **Business analytics programs will continue to grow.**
  100+ business schools in the United States that have, or have committed to launch, curriculum at the undergraduate and graduate levels with degrees or certificates in business analytics http://www.analytics-magazine.org/

- **Data scientists will be the head-hunter's best friend.**
  The past year 2015 has seen the number of advertised data scientist jobs in the UK increase by 22 percent, in addition to the push from the nation's tech sector for 'data scientist' to be added to the UK's skills shortages list.

Four analytics trends to watch in 2016 http://www.itproportal.com/2016/01/08/four-analytics-trends-to-watch-in-2016/

商业与数据分析 – Trend analysis cont.

- **6 Predictions in 2017 For The $203 Billion Big Data Analytics Market.**
  - The creation and consumption of data continues to grow by leaps and bounds and with it the investment in big data analytics hardware, software, and services and in data scientists and their continuing education.

http://www.forbes.com/sites/gilpress/2017/01/20/6-predictions-for-the-203-billion-big-data-analytics-market/

- **10 Predictions For AI, Big Data, And Analytics in 2018**
  - **25% of enterprises will supplement point-and-click analytics with conversational interfaces.**
  - **Data engineer will become the hot new job title.** 13% of data-related job postings on Indeed.com are for data engineers, versus less than 1% for data scientists, reflecting the trend of big data initiatives becoming mission-critical and the need to provide broader support to the business analyst.

https://www.forbes.com/sites/gilpress/2017/11/09/10-predictions-for-ai-big-data-and-analytics-in-2018/

商业与数据分析 – UK & Manchester

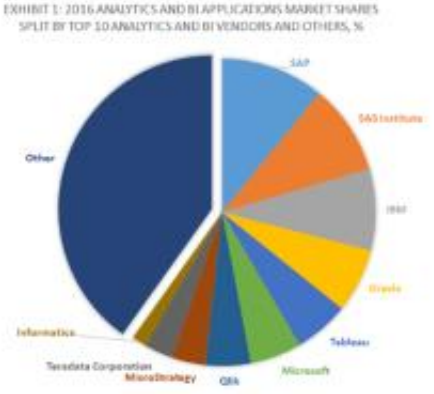
https://invest.great.gov.uk/us/industries/technology/data-analytics/

https://www.turing.ac.uk/

http://www.datascience.manchester.ac.uk/

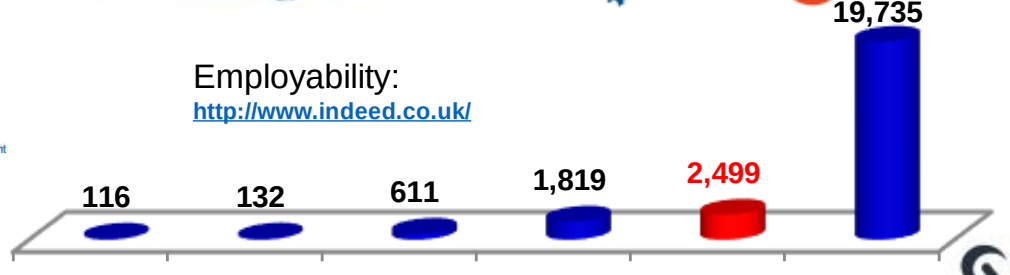
SAS – UK & Manchester

- 支持商业决策分析的数据分析方法和技术



Geoffrey Taylor
Head of Academic Engagement,
SAS UK & Ireland

Employability:
http://www.indeed.co.uk/



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商业决策分析问题与方法

- 战略层，战术层，运作层的决策问题

- Strategic planning
  - New business opportunities
  - Competition strategies
  - Technology adoption
  - Strategic partnership …
- Managerial control
  - Financial control
  - Project control
  - Quality control
  - Risk control…
- Operational control
  - Task scheduling
  - Process control
  - Production optimization
  - Fault diagnosis
  - System reliability …

1 in 3 Business leaders frequently make decisions based on information they don't trust, or don't have

60% of CEOs need to do a better job capturing and understanding information rapidly in order to make swift business decisions

IBM, Big Data Analytics, Academic Days Conference, Frankfurt, May 2012

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- 传统的决策理论方法

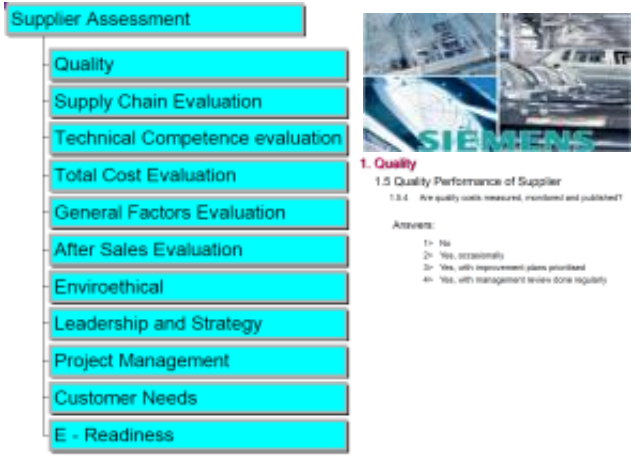
Purchase of Real Estates: Apartment, Office or Warehouse?

Decisions (Purchase)	States of Nature (Economy)		
	Better	Stable	Worse
Apartment	£40,000	£35,000	£30,000
Office	£100,000	£40,000	-£40,000
Warehouse	£50,000	£45,000	£10,000

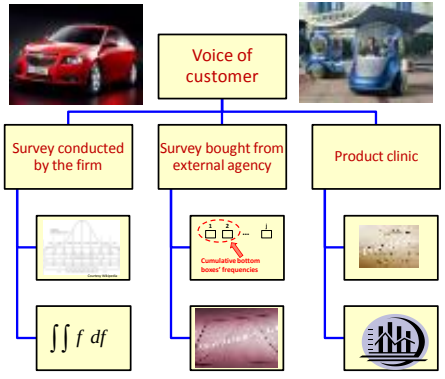
商业决策分析案例

- Design selection, risk & safety analysis

- Supplier assessment and selection



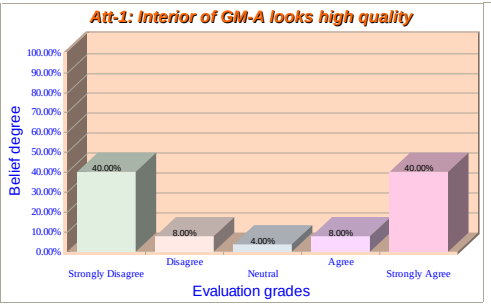
- Prioritise voices of customer

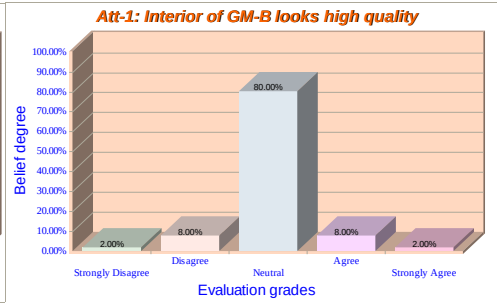


- Target identification

商业决策分析挑战与机遇

- 数据均值的缺陷





- Frequencies of customer responses from external surveys
- Is GM-B of the same priority to GM as GM-A in future design?

The Flaw of Averages distorts everyday decisions in many areas

销售预测 – Sales forecasting

- 商业决策问题：零售数据的销售预测
  Forecasting the 6 weeks of daily sales for 1,115 stores in Germany
  More reliable sales prediction leads to increasing profitability & productivity
- 研究方法：Data processing, predictive modelling, visualisation, etc.
- 硕士生: MSc Business Analytics students

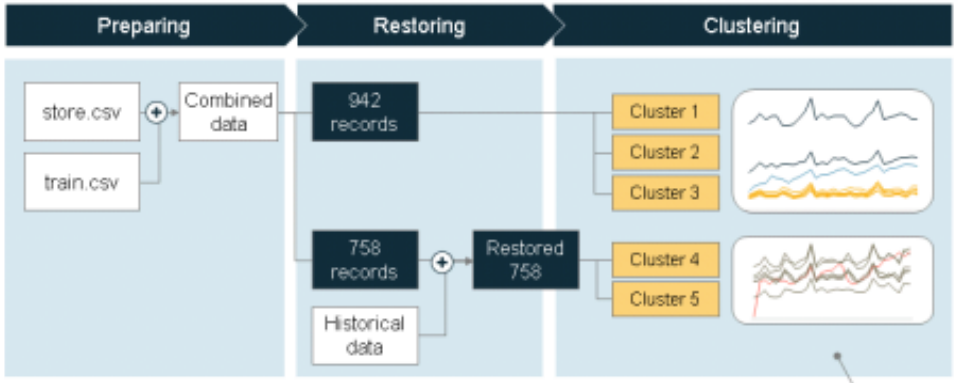
1,115 store across Germany

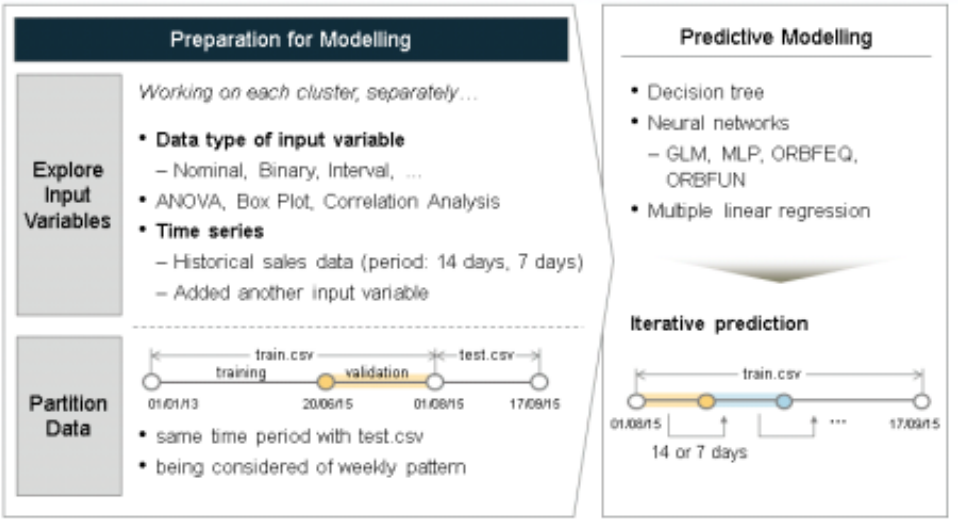
Assortment

Store Type	a	b	c	Total
a	381	-	221	**602**
b	7	9	1	**17**
c	77	-	71	**148**
d	128	-	220	**348**
Total	**593**	**9**	**513**	**1,115**

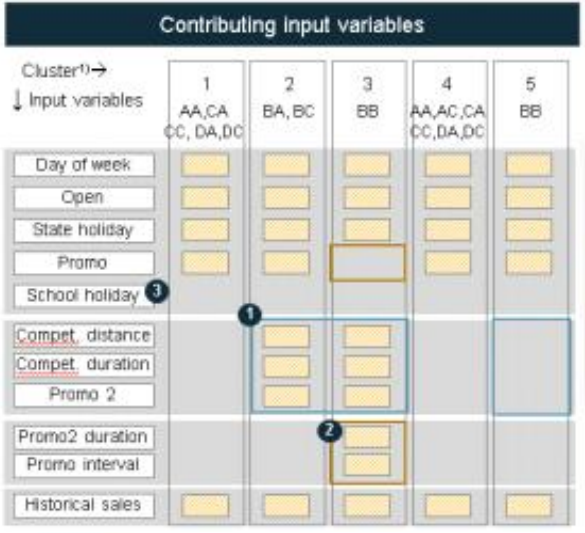
2.5 Years of sales (2013, 2014 and first semester of 2015)

销售预测 – Analytical solution



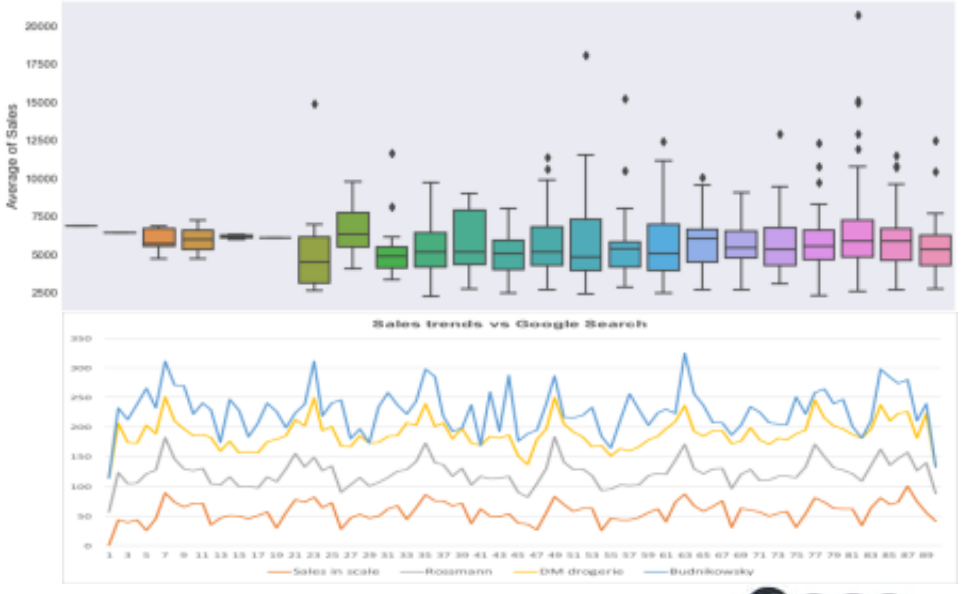


销售预测 – Analytical findings



Implication

1. **Store type B** should consider
   - Distance of competitors
   - Duration of competitor stores' open days
   - Promotion 2
2. **Store type B & Assortment B** should consider
   - Duration of promotion 2
   - Promo interval
     → more important than implementation of promotion
3. School holiday: not influential input



消费者偏好建模与预测

- 商业决策问题：消费者偏好建模与预测
  Customer preference modelling and prediction
- 研究方法：Predictive modelling, 置信规则库模型 – Belief rule-based model
- 博士毕业生: Dr. Emanuel-Emil Savan

Consumer:
Do you like it?

Consumer rating

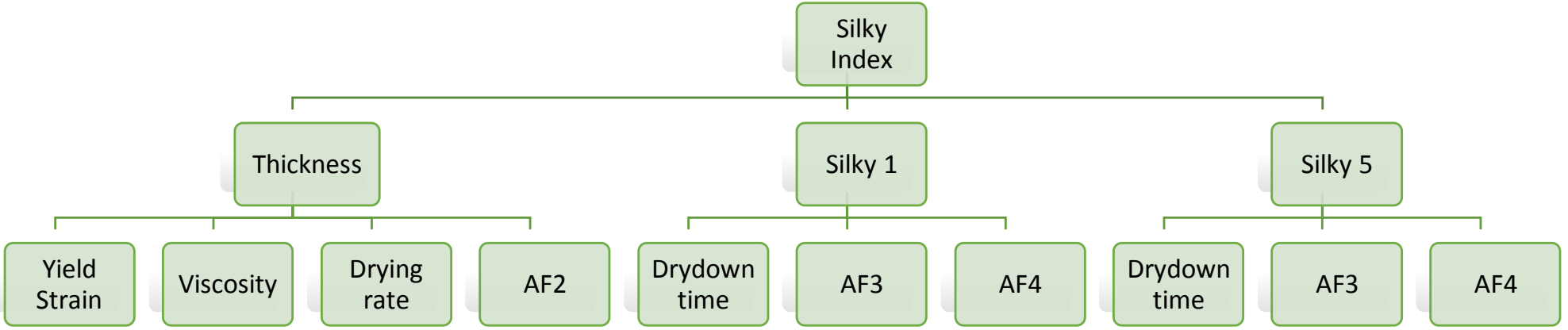
Random samples

Designer:
What's in it?

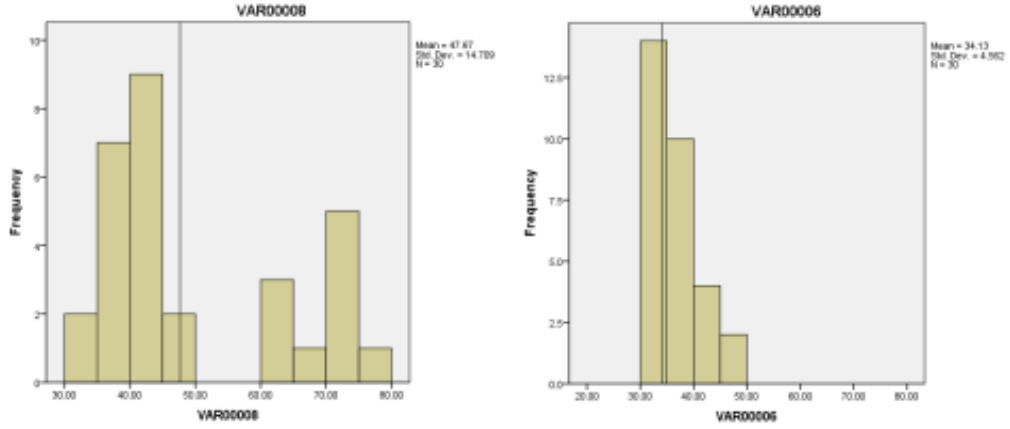
Product profile

How are they linked?

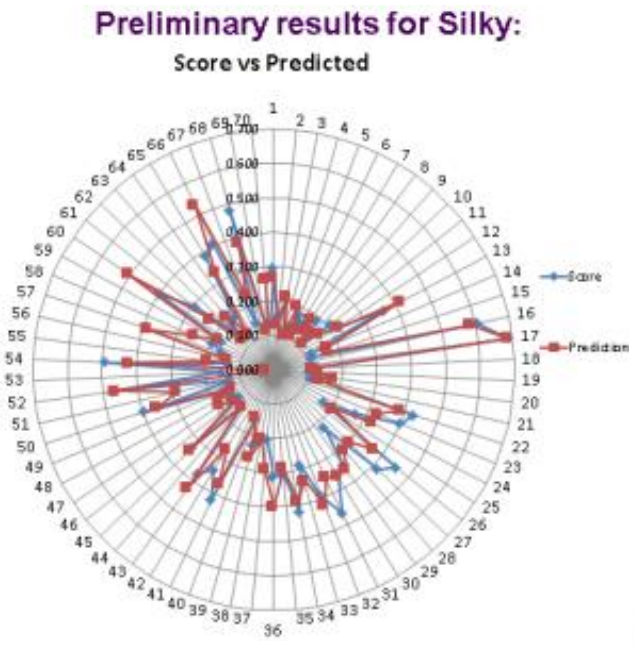
消费者偏好建模 – Sensory attributes



消费者偏好预测 – Distributed customer likings

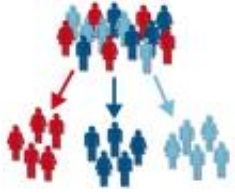


Distributions of customer likings on the sensory attribute of Thickness assessment from consumers for two different prototype products



消费者行为细分与预测

- 商业决策问题：消费者行为细分与预测
  Data-driven Segmentation and Prediction of Consumers' Purchase Behaviour in the Retail Industry
- 研究方法：数据聚类分析 – Clustering analysis, 马尔可夫链 – Markov chain
- 博士毕业生: Dr. Cheng Luo, 硕士毕业生: Mr. George Carmichael


消费者行为细分与预测 – Formulation

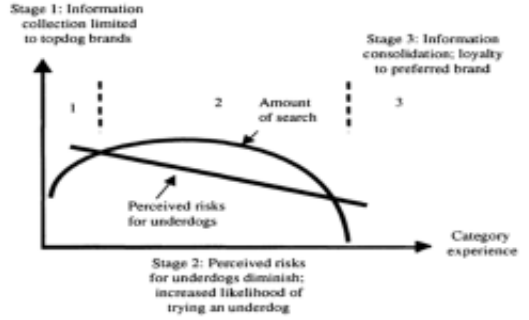
- 消费者行为描述: promotion proneness & variety seeking with store scanner data.
- 分析数据: IRI marketing dataset - 589 consumers with 169678 purchase records for a US salt-snack market market, (Bronnenberg et al., 2008).
- 理论基础: Brand choice model (Bucklin et al., 1998) - segment consumers based on their reactions to sales promotion in brand choice. Variety seeking (Heilman et al., 2000) - inverted U-relationship between expected value of information and the amount of market knowledge.

Promotion proneness – prevalence of promotion

Prevalence of promotion = The total number of purchases on promotion in a period / The total number of purchases in the period

Variety seeking - expected value of information

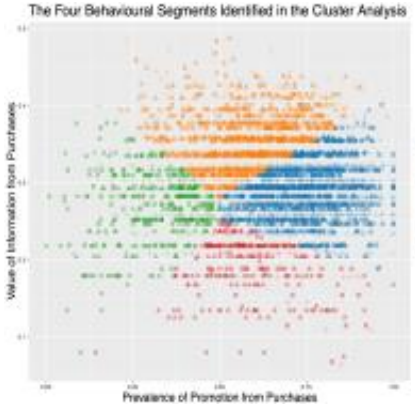
Expected value of information = Knowledge about a product market * The unit value of information = - I(M)p $*log_2$(I(M)p) = - (n/N) * log_2 (n/N)

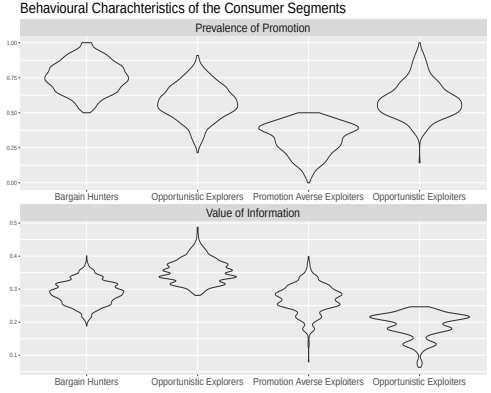


Dynamic choice process (Heilman et al., 2000)

Bronnenberg, B., Kruger, M. & Mela, C., 2008. The IRI Marketing Data Set. *Marketing Science,* 27(4), pp. 745-748.

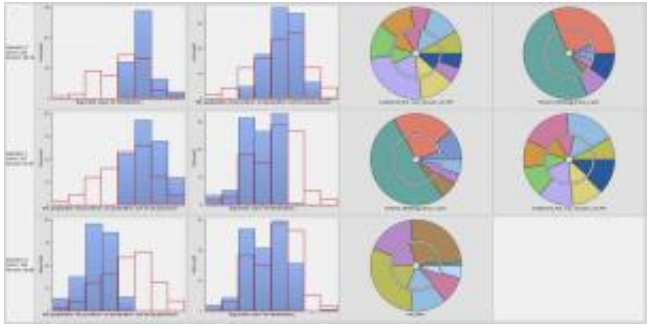
消费者行为细分与预测 – Clustering analysis

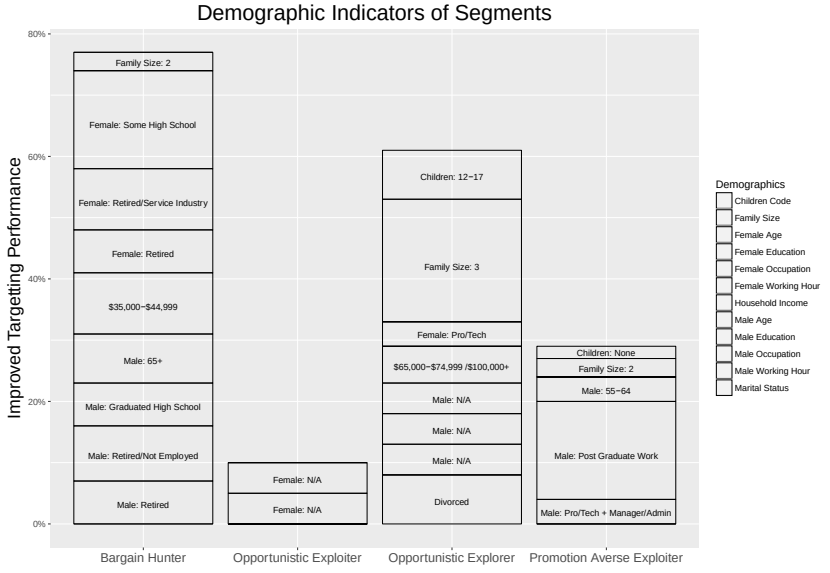




Segment Name	Prevalence of Promotion	Value of Information	Definition
Bargain Hunters	High (0.75)	Medium (0.29)	Actively looking for promotions to maximise the immediate purchase value.
Opportunistic Explorers	Medium (0.58)	High (0.35)	Motivated to try new brands. Promotions are used to enable this market exploration.
Promotion Averse Exploiters	Low (0.32)	Medium (0.26)	Purchase brands that are well known to them. Unwilling to risk new brands regardless of promotions.
Opportunistic Exploiters	Medium (0.6)	Low (0.19)	Purchase items that they are familiar with to reduce the risks involved whilst taking advantages of promotions where possible.

消费者行为细分与预测 – Profiling and prediction





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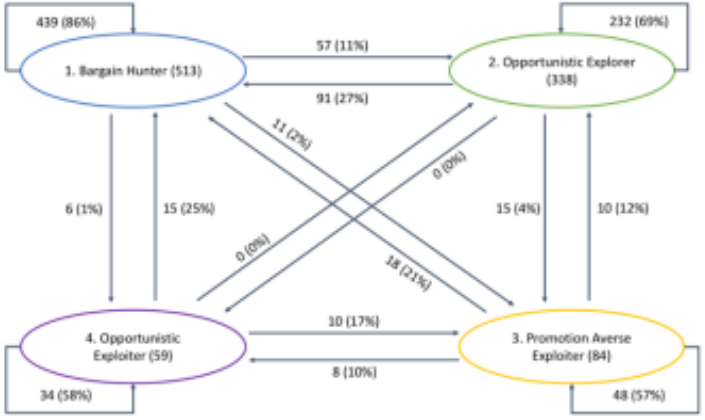
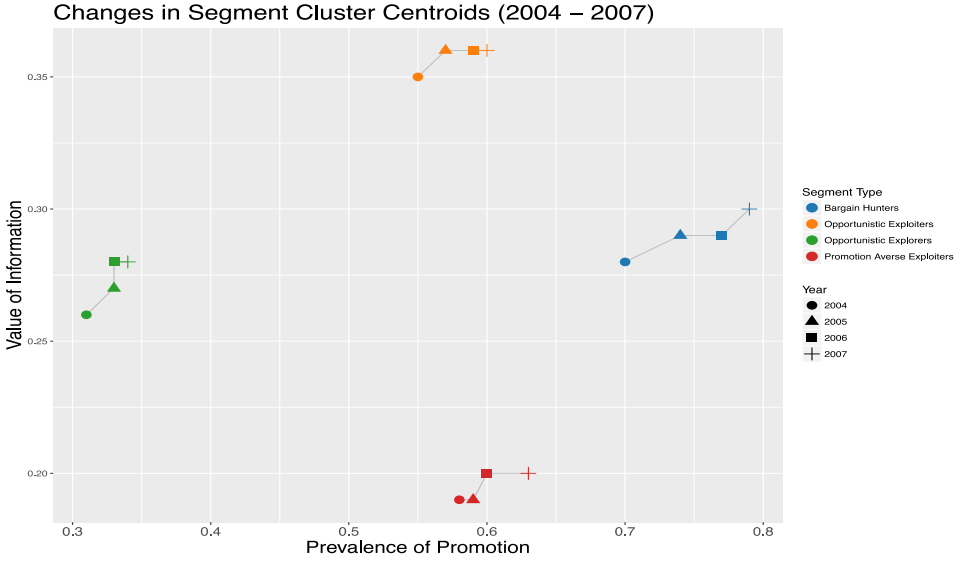
消费者行为细分与预测 – Behavioural evolvement



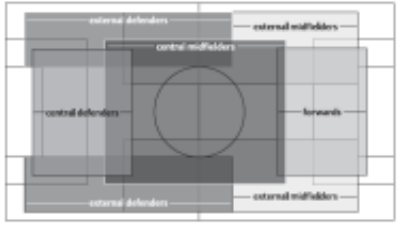
Segment transitions between two consecutive years

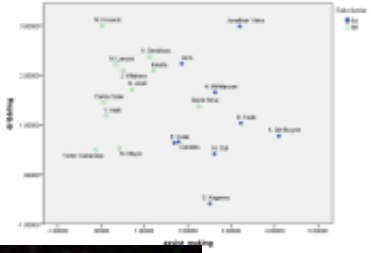


Cluster centroid tracking over four years

足球数据分析 – Football Analytics

- 商业决策问题：球员打法功能性分类，辅助转会市场中的商业决策。
  Discovering function-based categories of footballers
- 研究方法：数据聚类分析 – Clustering analysis
- 博士生: Mr. Orbay Unsoy





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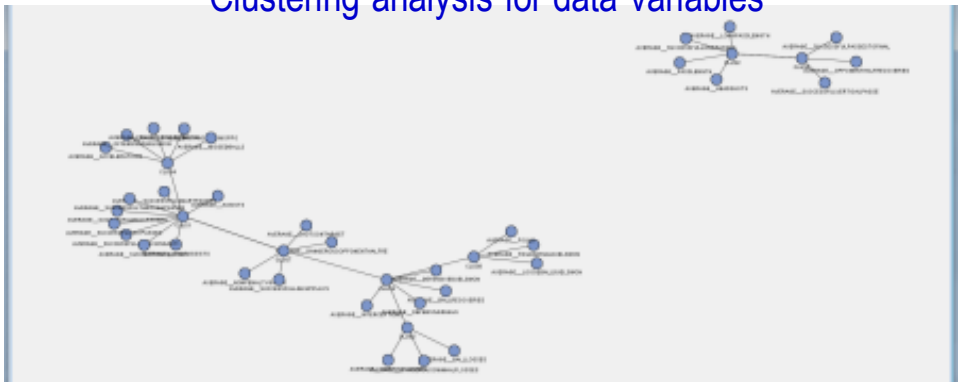
足球数据分析 – Variable clustering

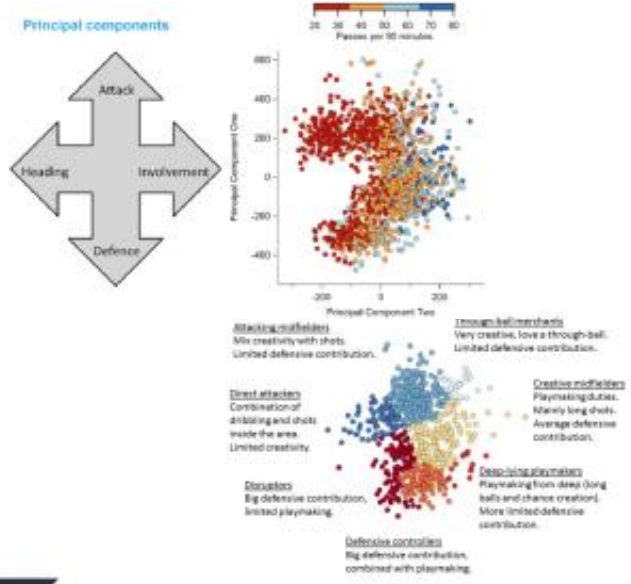
Variable label	Variable type
Accelerations	on the ball
Assists	on the ball
Ball losses	on the ball
Ball recoveries	off the ball
Dangerous opponent half recoveries	off the ball
Dangerous own half losses	on the ball
Defensive duels	off the ball
Defensive duels won	off the ball
Dribble distance from opponent goal	on the ball
Aerial duels won	off the ball
Fouls	off the ball
Head shots	on the ball
Interceptions	off the ball
Long pass length	on the ball
Long passes	on the ball
Missed balls	on the ball
Non-penalty goals	on the ball
Offensive duels won	on the ball
Opponent half recoveries	off the ball
Own half losses	on the ball
Pass length	on the ball
Shot assists	on the ball
Shots on target	on the ball
Successful attacking actions	on the ball
Successful back pass	on the ball
Successful crosses	on the ball
Successful dribbles	on the ball
Successful key pass	on the ball
Successful linkup play	on the ball
Successful long passes	on the ball
Successful passes to final third	on the ball
Successful smart passes	on the ball
Successful through pass	on the ball
Successful vertical pass	on the ball

Data variables

Clustering analysis for data variables



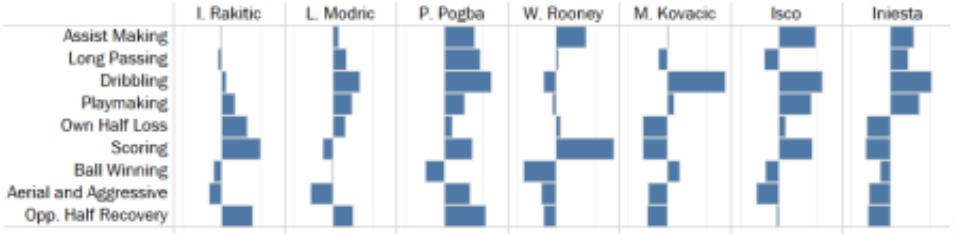
足球数据分析 – Clustering



Cluster No.	Assist Making	Long Passing	Dribbling	Playmaking	Own Half Loss	Scoring	Ball Winning	Aerial and Aggressive	Opp. Half Recovery
1	-0.66	0.06	-0.26	-0.27	0.86	-0.35	0.75	0.45	-0.38
2	-0.45	-0.11	-0.08	-0.70	0.38	1.36	0.19	1.92	0.60
3	0.25	-0.24	0.02	0.10	-0.24	-0.15	-0.55	-0.50	0.15
4	-0.44	0.44	-0.76	-0.57	-0.66	-0.37	0.21	-0.36	-0.65
5	-0.21	0.91	-0.49	1.09	-0.46	-0.63	0.63	-0.29	0.56
6	0.19	0.35	1.06	1.50	0.47	0.23	0.01	0.22	1.83
7	0.94	-1.07	0.36	-0.63	-0.65	1.73	-1.45	-0.07	-0.24
8	1.51	-0.75	1.41	0.13	-0.19	-0.26	-1.00	-0.92	-0.34

Low High

Component mean scores for variable clusters



Component mean scores for representative players

Thank you！

Email: yu-wang.chen@manchester.ac.uk

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激发非凡

INSPIRE
THE EXTRAORDINARY

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THE POWER TO KNOW.