Week 6 Unit 1: **Deployment Phase – Overview**

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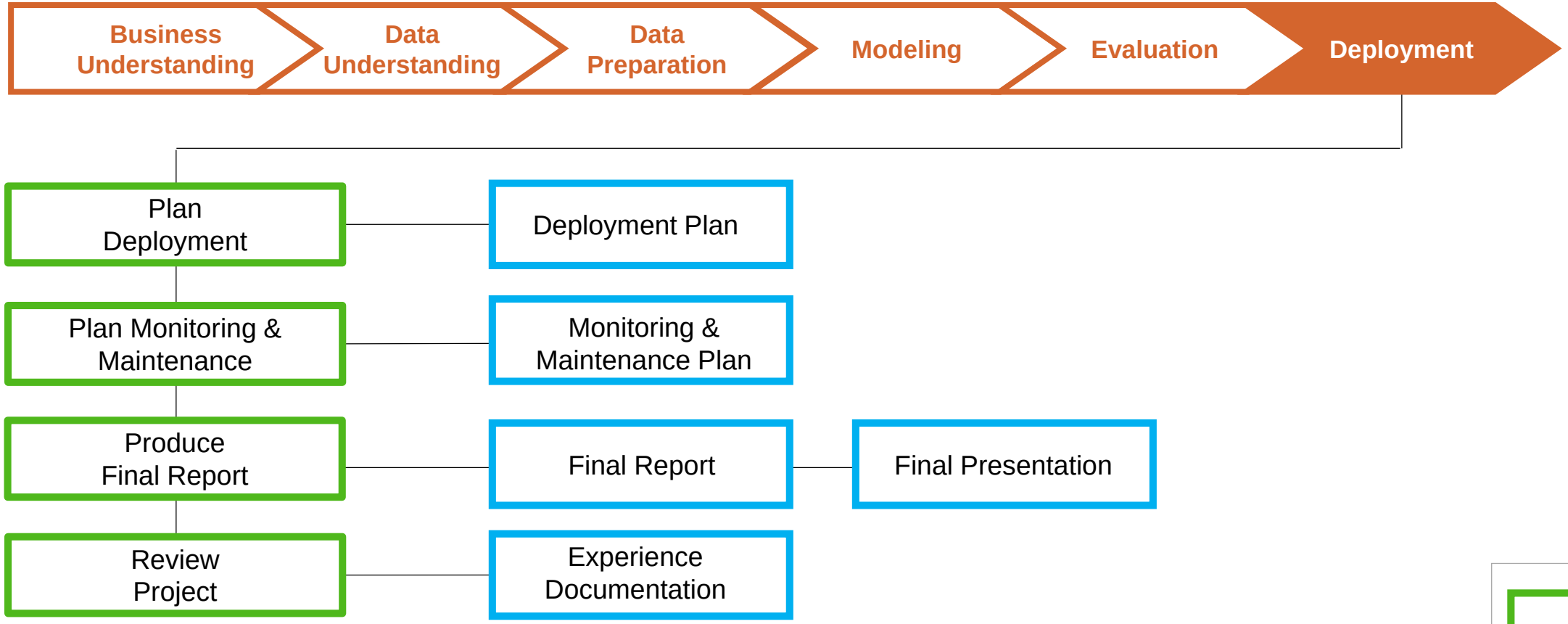
Deployment Phase – Overview

CRISP-DM – Phase 6: Deployment

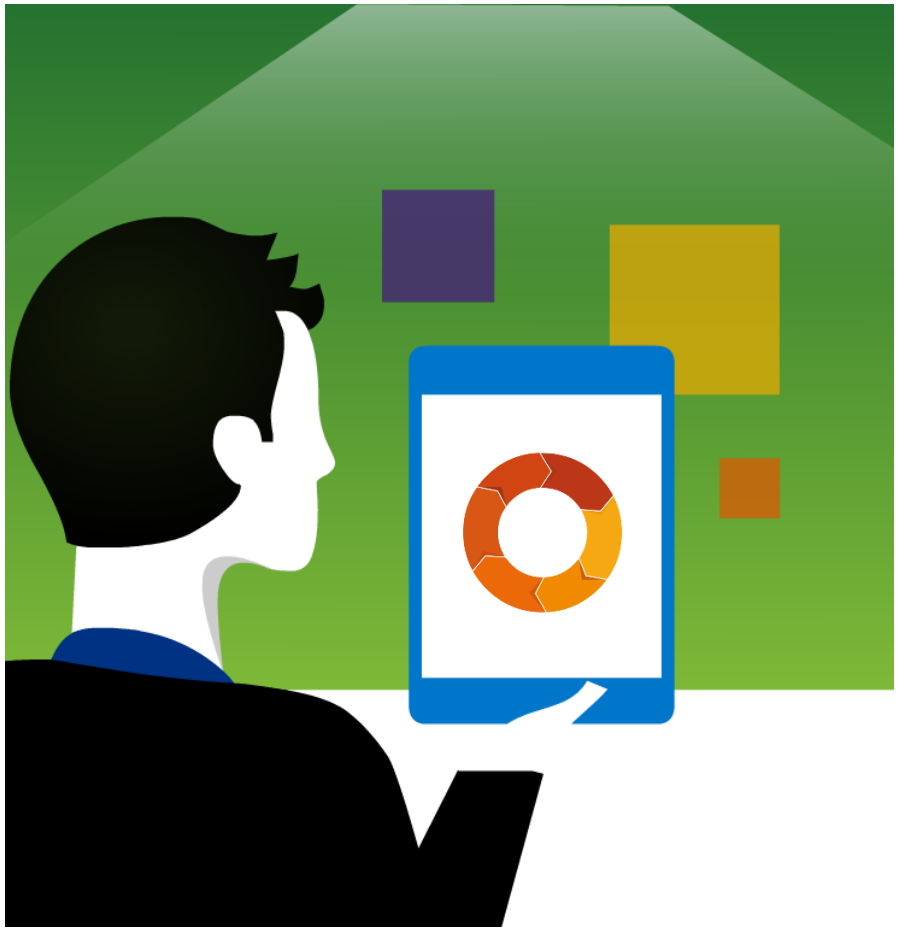


Deployment Phase – Overview

Phase 6.1: Plan Deployment

- **Task**
  - Plan deployment.

- **Output – Deployment Plan**
  - Summarize the deployment strategy, including the necessary steps and how to perform them.



Deployment Phase – Overview

Phase 6.2: Plan Monitoring & Maintenance

- **Task**
  - Monitoring and maintenance of models and analysis are critical issues.
  - A careful preparation of a maintenance strategy is essential.

- **Output – Monitoring and Maintenance Plan**
  - Summarize the monitoring and maintenance strategy.

Deployment Phase – Overview

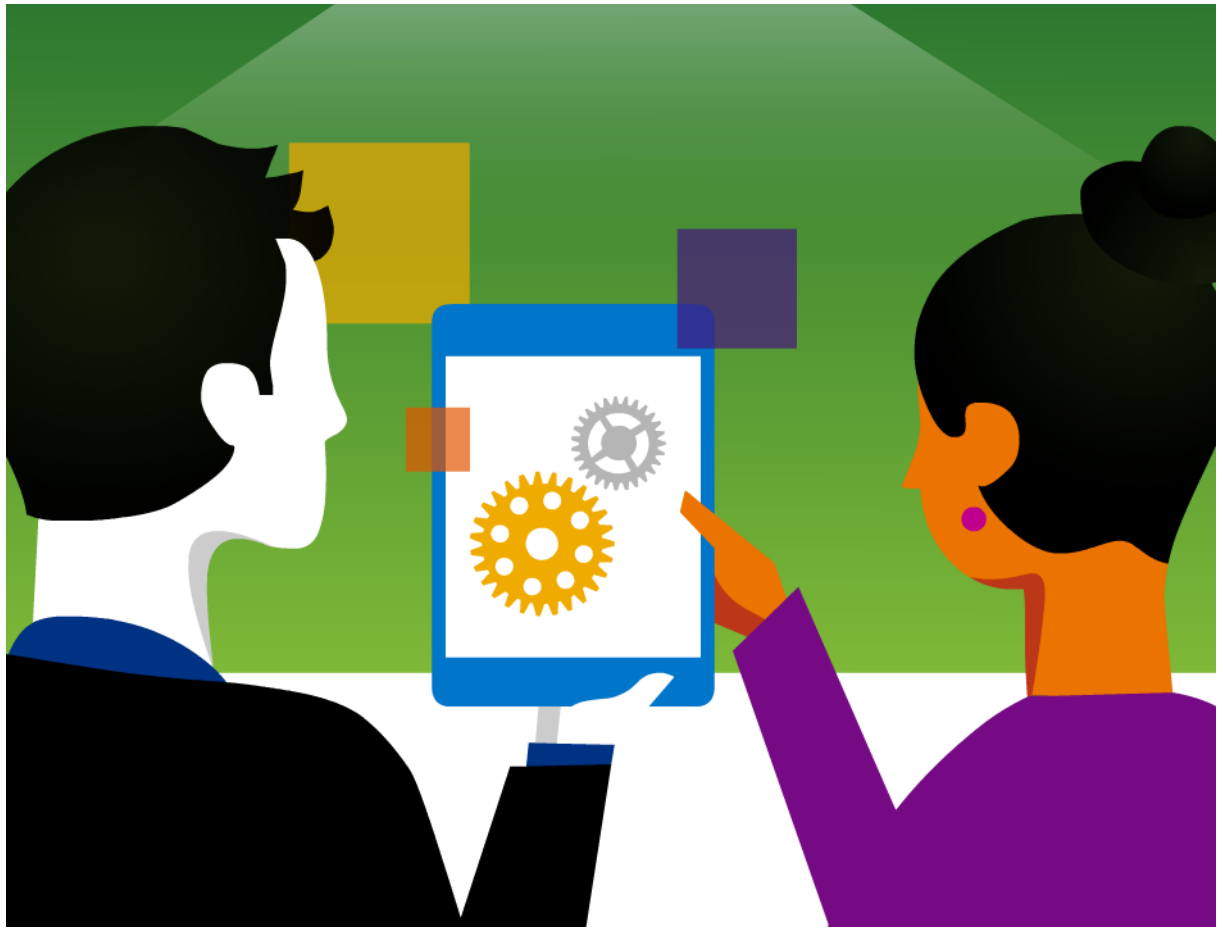
Phase 6.3: Produce Final Report

- **Task**
  - At the end of the project, the project leader and his team write up a final report.
- **Output – Final Report**
  - This is the final written report of the data mining engagement.
- **Output – Final Presentation**
  - There will also often be a meeting at the conclusion of the project where the results are verbally presented to the customer.

Deployment Phase – Overview

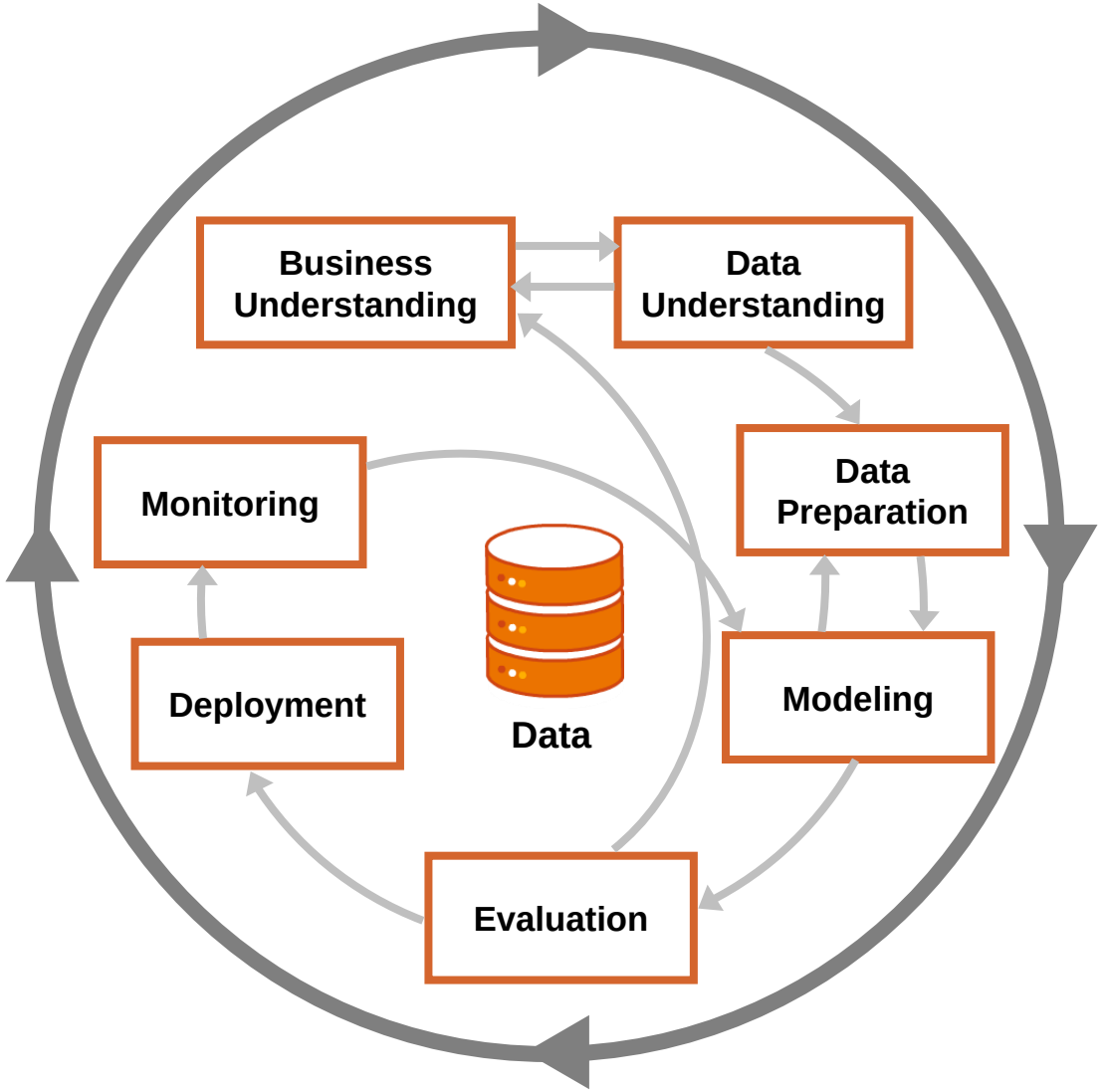
Phase 6.4: Review Project

- **Task**
  - Assess what went right and what went wrong, what was done well and what needs to be improved.
- **Output – Experience Documentation**
  - Summarize important experiences made during the project.



Deployment Phase – Overview

CRISP-DM – Update



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Week 6 Unit 2: **Deployment Options**

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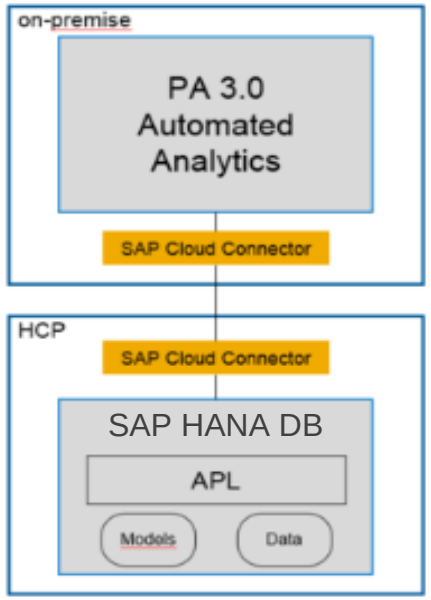
Deployment Options
Introduction

- There are a number of options to deploy the analysis:
  - Model scoring
  - Model integrated with BI Reporting
  - Model integrated with application
  - In the cloud

PA with SAP HANA DB via HCP



- Requirements
  - Predictive Analytics 3.0.0 on Premise Suite License
  - SAP HANA Cloud Platform with HCP predictive services deployed
  - APL 3.0.0 Deployed on HCP
  - Database Connection is made through SAP Cloud Connector
  - User needs APL rights on Database
  - Configure PA to delegate to APL

Deployment Options

PMML (Predictive Model Markup Language)

The Predictive Model Markup Language (PMML) is an XML language for statistical and data mining models, which makes it easy to move models between different applications and platforms.

```
<?xml version="1.0"?>
<PMML version="4.1"
  xmlns="http://www.dmg.org/PMML-4_1"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <Header copyright="Example.com"/>
  <DataDictionary> ... </DataDictionary>

  ... a model ...

</PMML>
```

General Structure of a PMML Document

Deployment Options

Real-time scoring

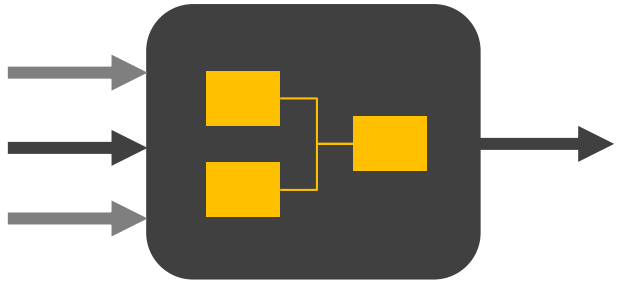
In some business applications, real-time scoring is necessary.

Deployment Options

What is event stream processing?

Real-time event stream processing

1. **Capture** data arriving continuously from devices and applications
2. **Act** on new information as soon as it arrives: alerts, notifications, and immediate response to changing conditions
3. **Stream** information to live operational dashboards



Highly scalable – processing hundreds of thousands or even millions of events per second

Deployment Options

Smart data streaming capabilities

Stream Capture

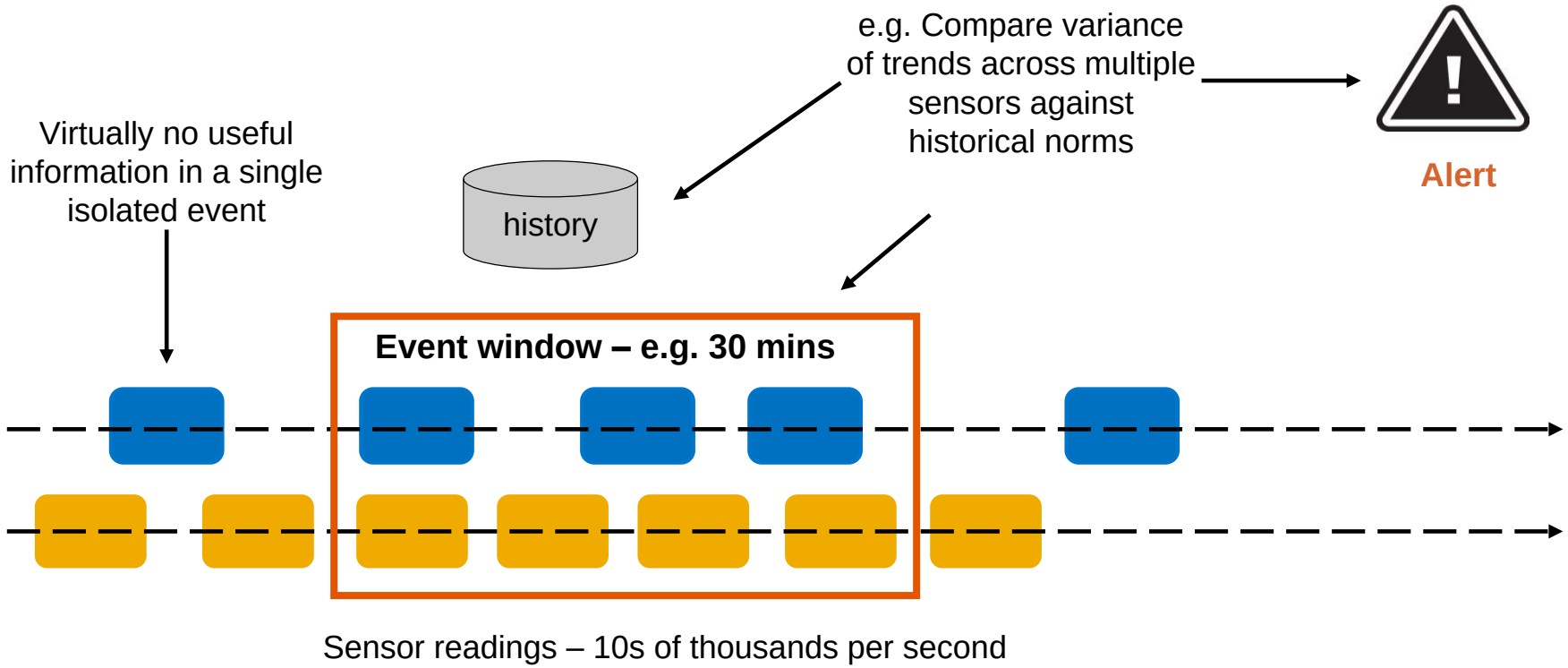
- **Capture data arriving as individual events – at potentially high speeds**
  - Hundreds of thousands or millions of events per second
  - Micro-batching and parallel processing to optimize load speeds
- **Capture events that are published from streaming sources**
  - e.g. message bus
- **Filter, transform, or enrich the data on the way in**
  - Capture only the data you want, in the form you need it
- **Prioritize data**
  - Capture high value data in SAP HANA and direct other data into Hadoop

Immediate Response

- **Monitor incoming event streams**
  - Watch for **trends or patterns**
  - Monitor **correlations**
  - Detect **missing events**
  - **Continuously update and monitor** aggregate statistics
- **Generate alerts, notifications**
- **Initiate immediate response**

Deployment Options

Complex event processing extracts insight from events



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Week 6 Unit 3: **Monitoring & Maintenance**

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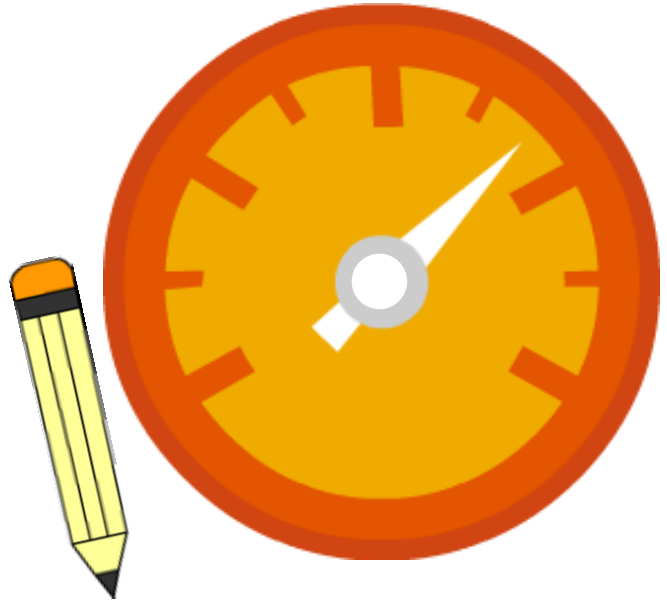
Monitoring & Maintenance

Introduction

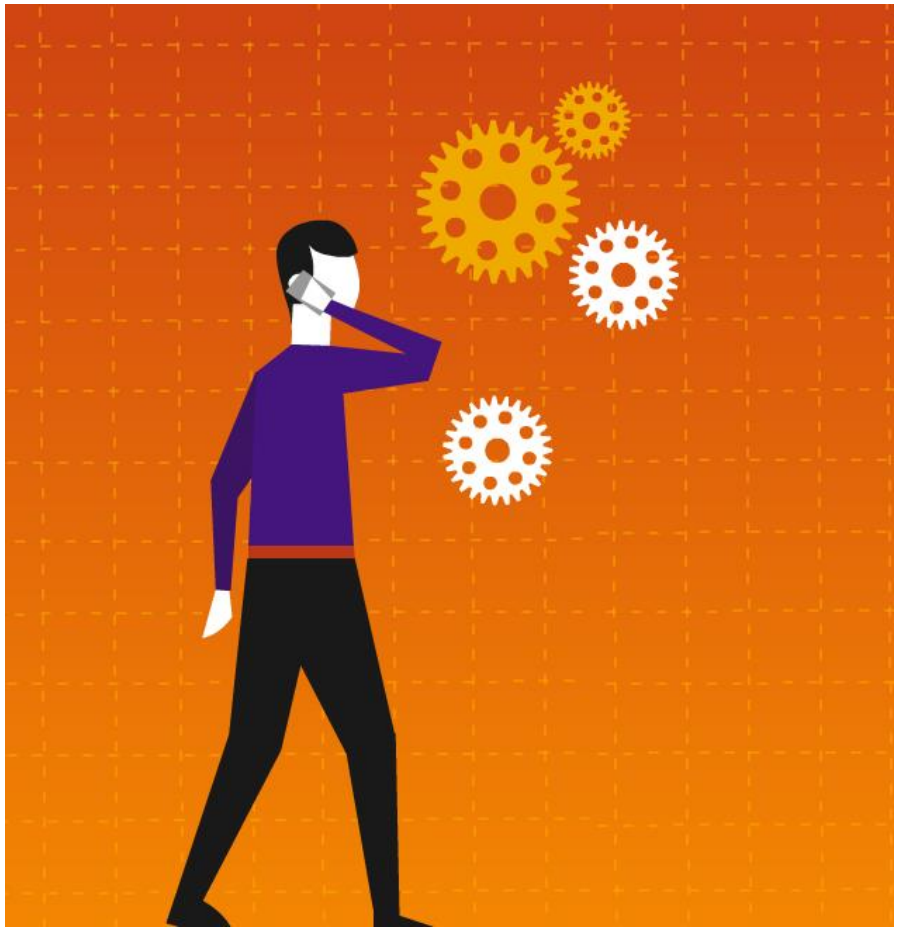
- The predictive models that have been deployed into the business environment must be regularly monitored for acceptable performance.
- Remember – model performance will reduce over time.



Monitoring & Maintenance

Approach

- Each model should be thoroughly evaluated and measured for accuracy, predictive power, stability over time, and other appropriate metrics that are defined by each model's objectives.



Monitoring & Maintenance

Update frequency

- Factors that influence when you should update your models:
  - Business environment change
  - Frequency of model usage
  - The age of a model
  - Data readiness

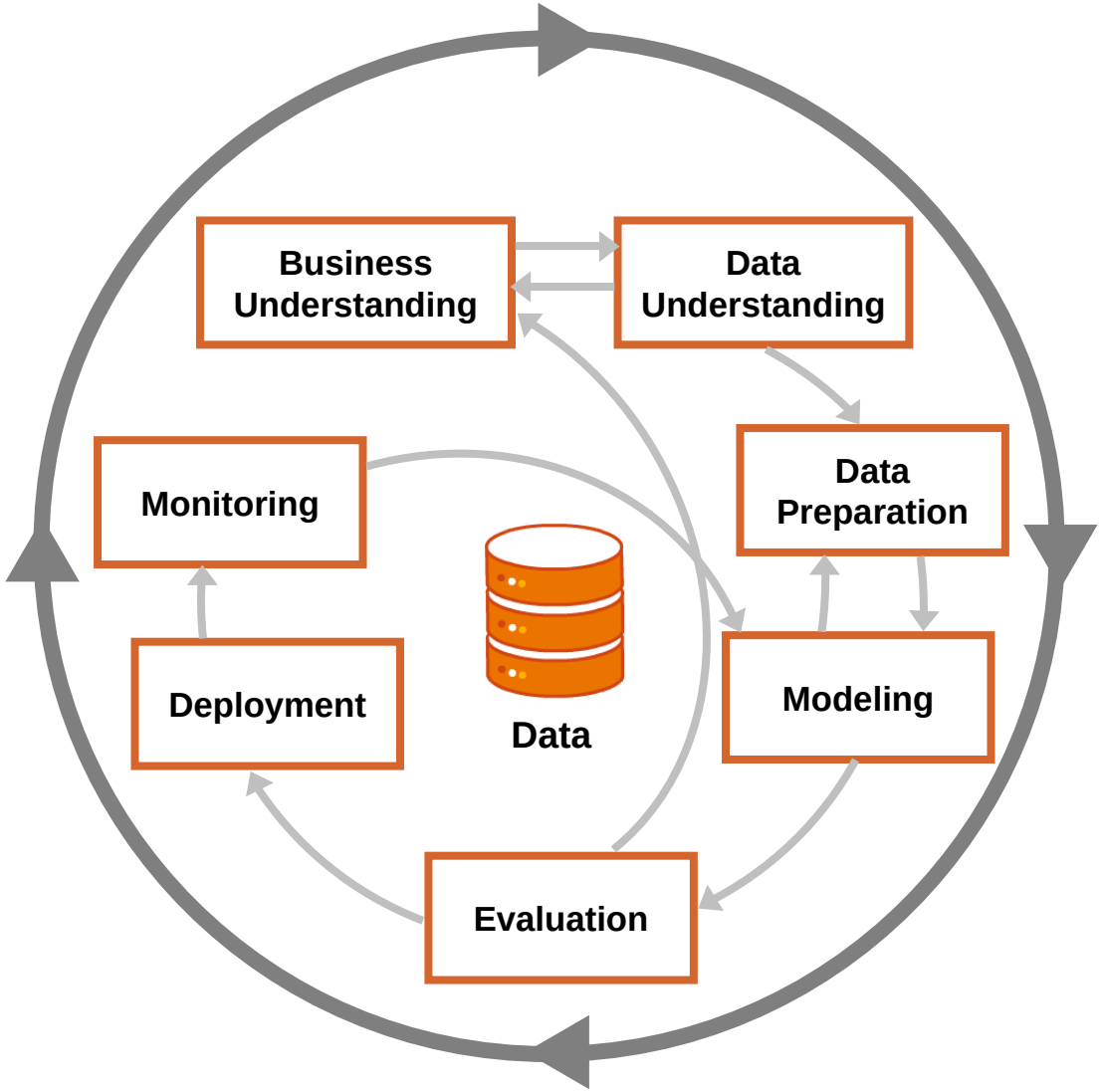
Monitoring & Maintenance

Process

- Those models that are not running at their best may need to be refreshed (or recalibrated) with current data or rebuilt completely.

Monitoring & Maintenance

CRISP-DM – Update



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Week 6 Unit 4: **Automating Deployment & Maintenance**

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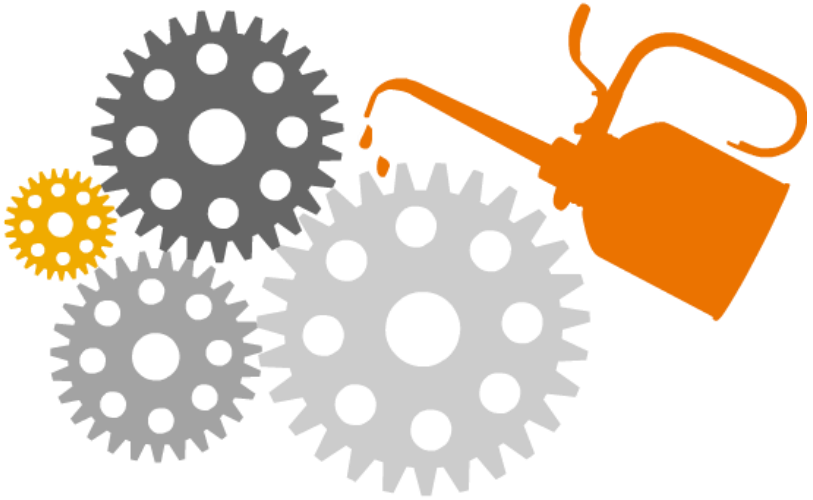
Automating Deployment & Maintenance

Introduction

- Once an organization has developed 100s or possibly 1000s of predictive models, it becomes very difficult to apply them on new data and maintain them over time.
- Therefore, it is important that the processes of deploying and maintaining models can be automated, so that they can be achieved as efficiently as possible and free-up scarce data scientist resources.



Automating Deployment & Maintenance

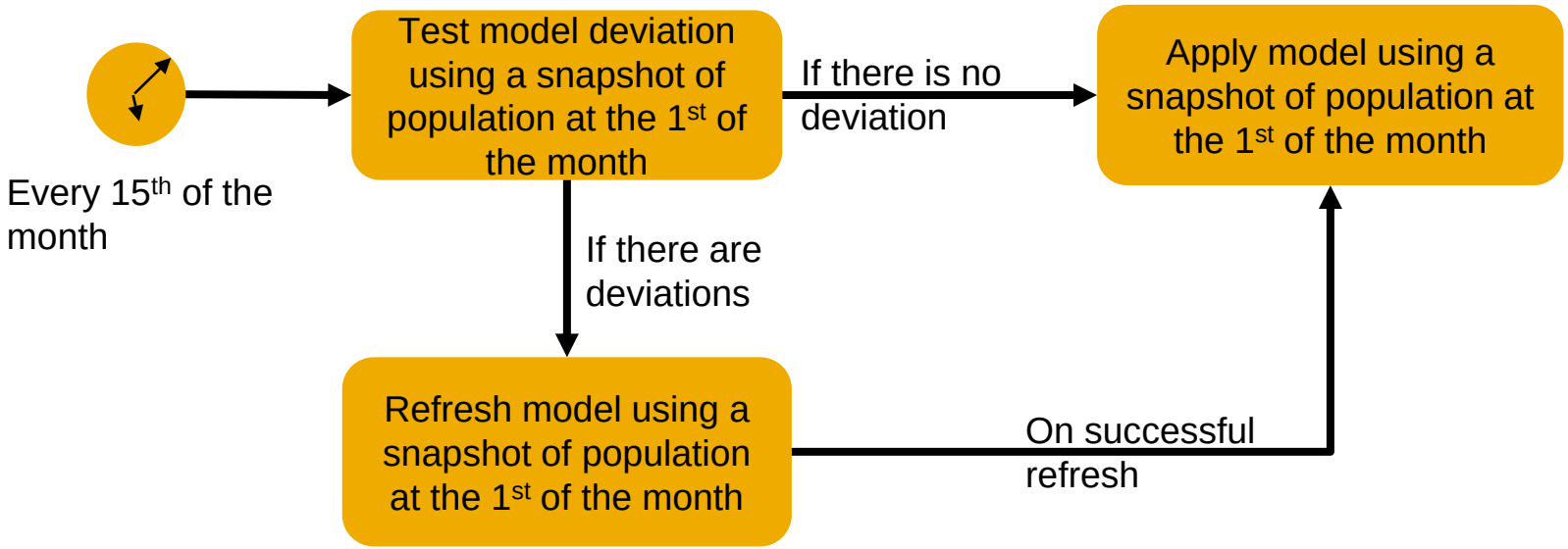
Basic processes

- There are a number of basic processes that require automation:
  - Model scheduling
  - Apply dataset build
  - Data deviation
  - Model deviation analysis
  - Time series anomaly
  - Automated model refresh or rebuild

Automating Deployment & Maintenance

Model automation scenario (workflow)

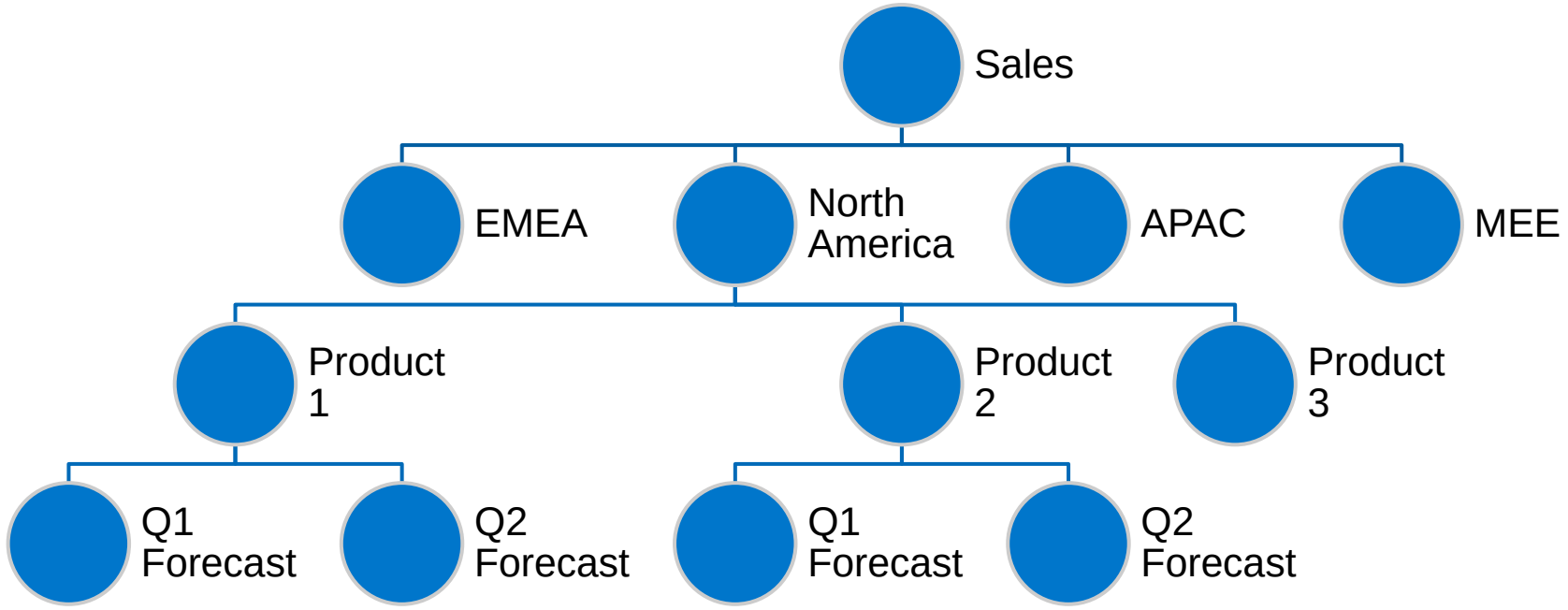
Here is an example workflow of tasks we might want to set up:



Automating Deployment & Maintenance

Segmented modeling in SAP Predictive Factory

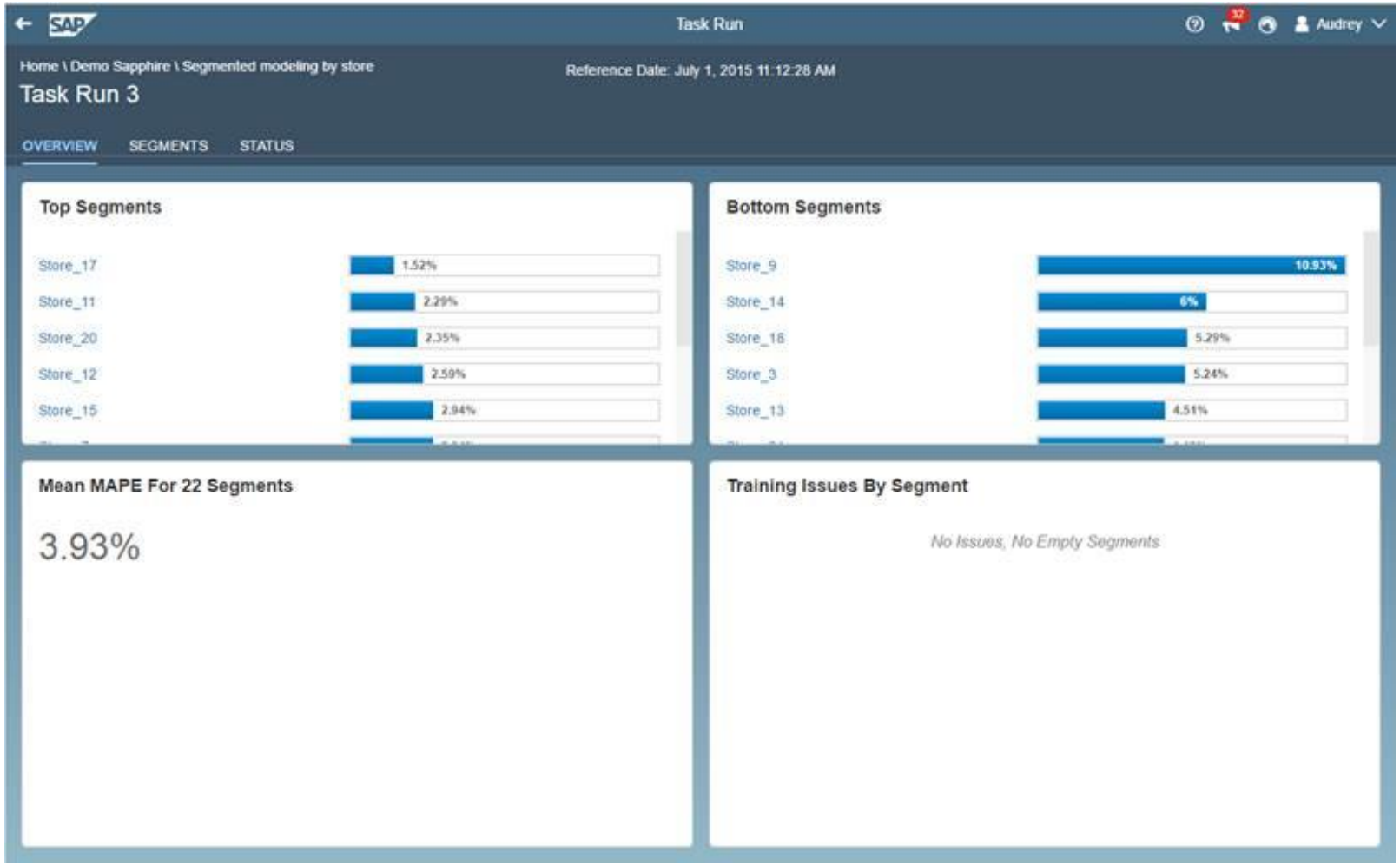
One of the features of the SAP Predictive Factory is that it enables automated segmented modeling for a time series model.



Build thousands of models in a single operation

Automating Deployment & Maintenance

Segmented modeling in SAP Predictive Factory



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Week 6 Unit 5: **Myths & Challenges**

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Myths & Challenges

Myth 1 – Data science is all algorithms

$$H(P,Q) := \sqrt{\frac{1}{2}\int\left(\sqrt{\frac{dP}{d\lambda}}-\sqrt{\frac{dQ}{d\lambda}}\right)^2 d\lambda}$$

$$\mathrm{Var}[a^T X] = \frac{1}{n}\sum_{i=1}^{n}\left\{a^T\left(X_i - \frac{1}{n}\sum_{j=1}^{n} X_j\right)\right\}^2 = a^T V_{XX} a.$$

where

$$V_{XX} = \frac{1}{n}\sum_{i=1}^{n}\left(X_i - \frac{1}{n}\sum_{j=1}^{n} X_j\right)\left(X_i - \frac{1}{n}\sum_{j=1}^{n} X_j\right)^T$$

$$W_p(\mu,\nu) := \left(\inf_{\gamma\in\Gamma(\mu,\nu)}\int_{M\times M} d(x,y)^p \,\mathrm{d}\gamma(x,y)\right)^{1/p}$$

$$f(x;\lambda,k) = \begin{cases} \frac{k}{\lambda}\left(\frac{x}{\lambda}\right)^{k-1} e^{-(x/\lambda)^k} & x \geq 0, \\ 0 & x < 0, \end{cases}$$

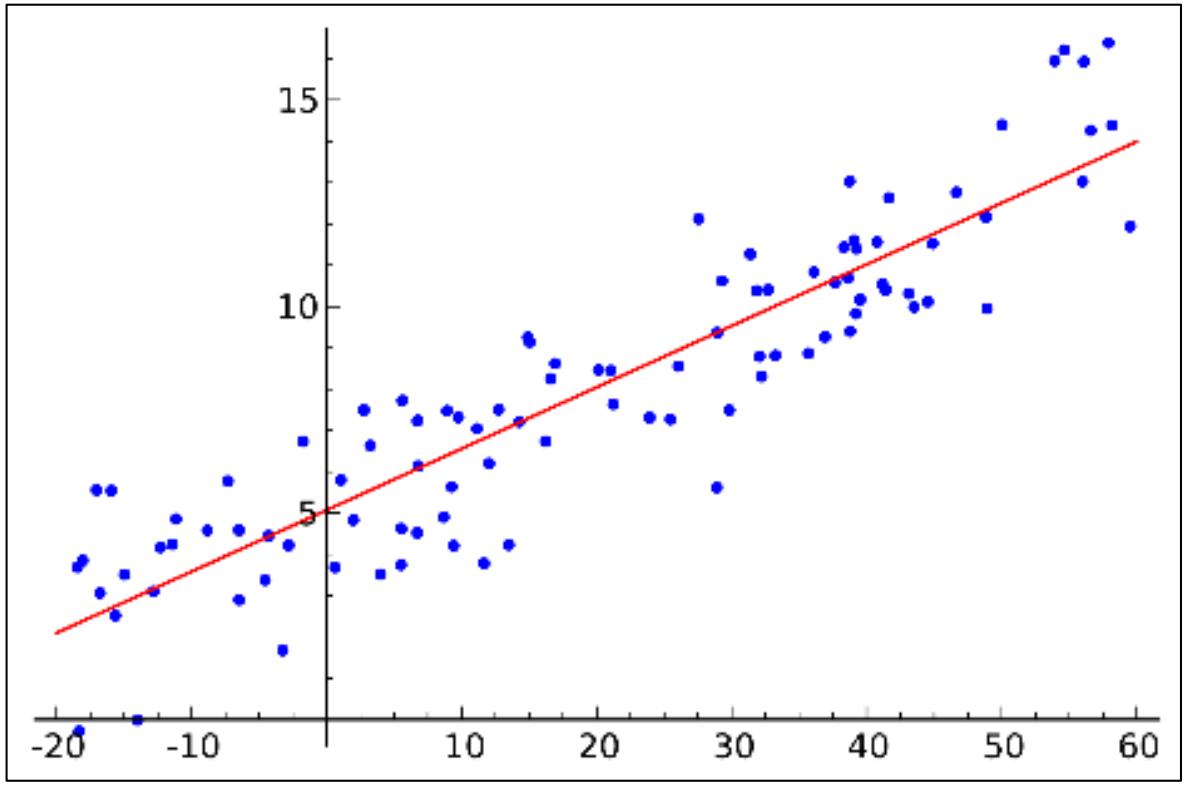
$$W(P,Q) = min\left\{\sum_{x\in M,\, y\in M} dist(x,y)\cdot T(x,y) \,\middle|\, T: M\times M \to [0,1] \; with \; \sum_{y\in M} T(x,y) = P(x), \; \sum_{x\in M} T(x,y) = Q(y)\right\}$$

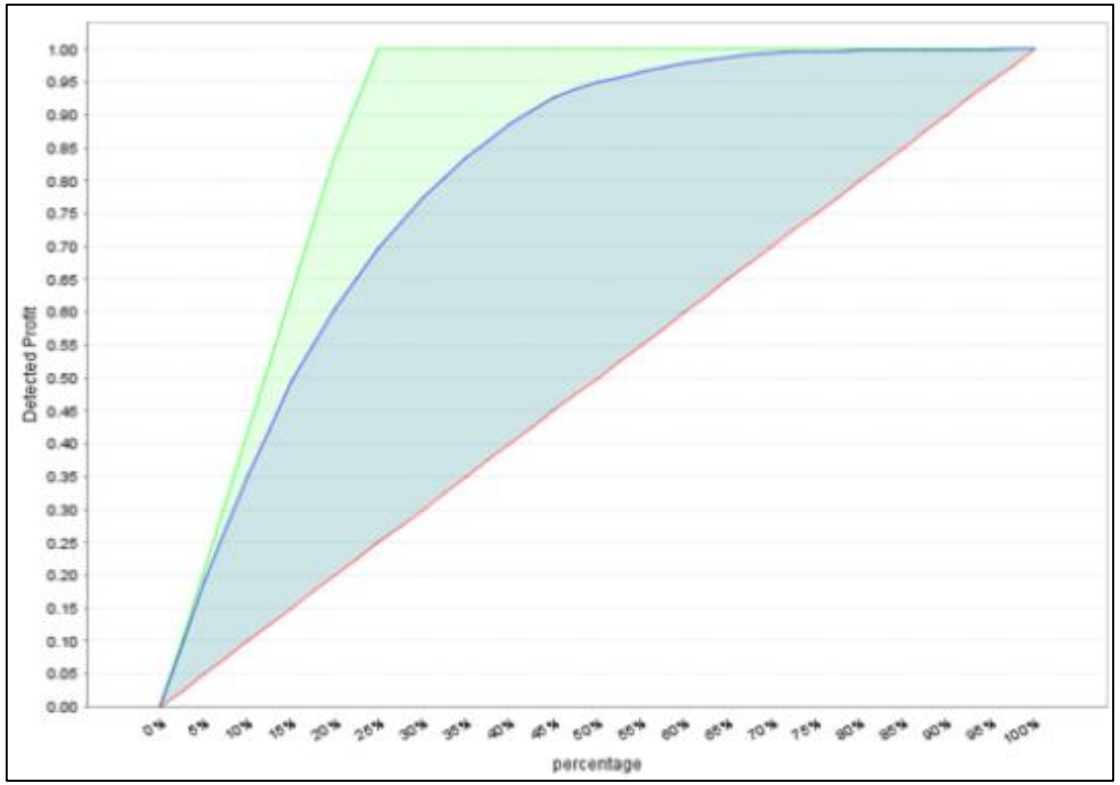
- You will often hear that “all you need for data science are good algorithms”!
- “Advances in data science = advances in algorithms”

Myths & Challenges

Myth 2 – Data science is all about accuracy

- You will also hear that “the main criterion for a good data mining algorithm is predictive accuracy”!





Myths & Challenges

Myth 3 – Data science is all about vast quantities of data

Many of the datasets we use in data science projects are relatively small, as this survey shows.

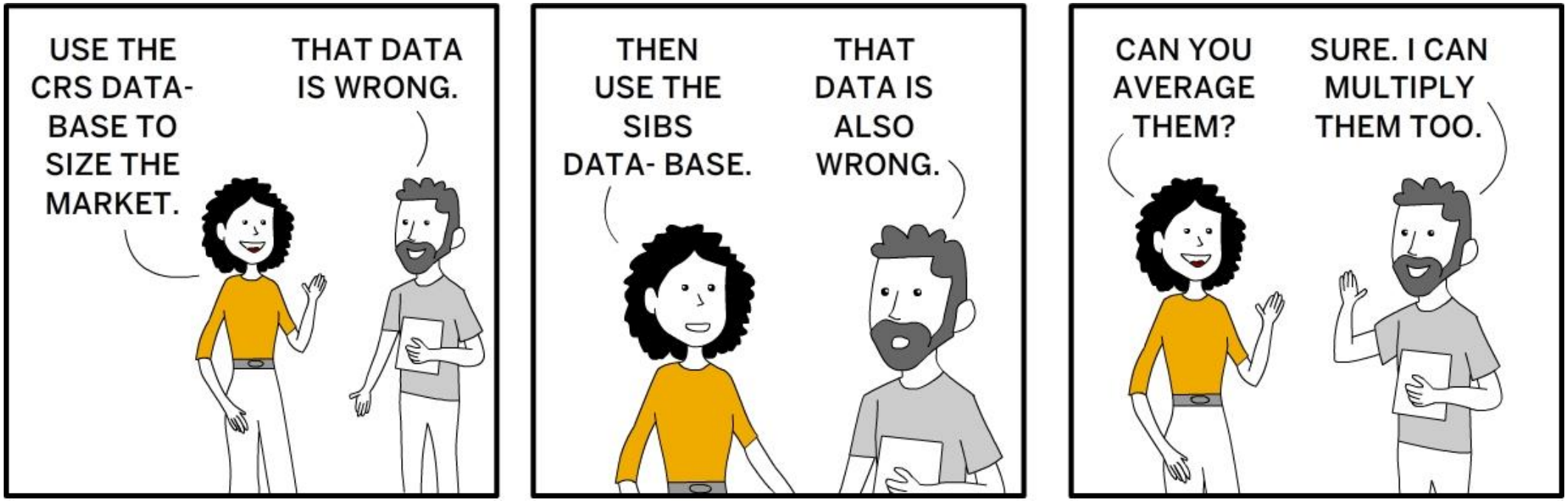
What was the largest dataset you analyzed / data mined? [459 voters]	
less than 1 MB (9)	2.0%
1.1 to 10 MB (19)	4.1%
11 to 100 MB (16)	3.5%
101 MB to 1 GB (55)	12.0%
1.1 to 10 GB (90)	19.6%
11 to 100 GB (80)	17.4%
101 GB to 1 Terabyte (85)	18.5%
1.1 to 10 TB (52)	11.3%
11 to 100 TB (21)	4.6%
101 TB to 1 Petabyte (11)	2.4%
1.1 PB to 10 Petabyte (4)	0.9%
11 to 100 PB (5)	1.1%
over 100 PB (12)	2.6%

From a KDnuggets poll (2015)

Myths & Challenges

Challenge 1 – Throwing in data without thinking

- You must think about the data you are going to use before blindly using it to be a model.
- Rubbish in = Rubbish out



Myths & Challenges

Challenge 2 – Lack of business knowledge

- Business knowledge is crucial to guide the data mining process towards useful results, and to recognize and use them once found.

Myths & Challenges

Challenge 3 – Lack of data knowledge

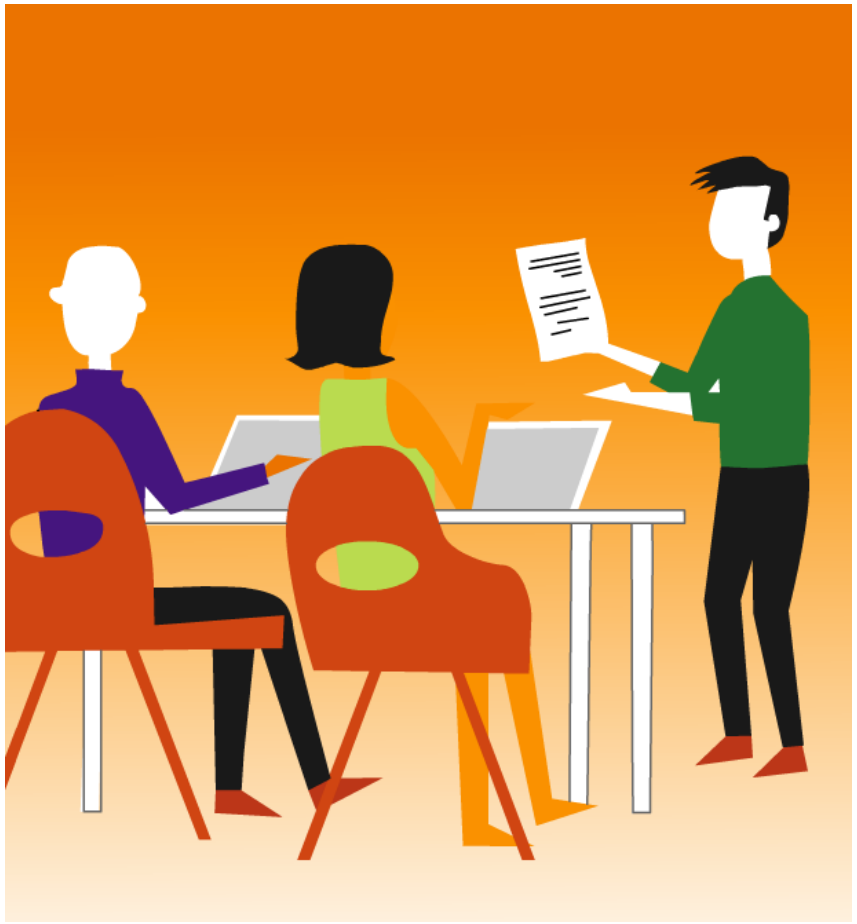
- Data science projects involve lots of low-level questions about the data.

Myths & Challenges

Challenge 4 – Erroneous assumptions

- Even with a lot of data knowledge, we can be misled.

$$2 + 2 = 5$$



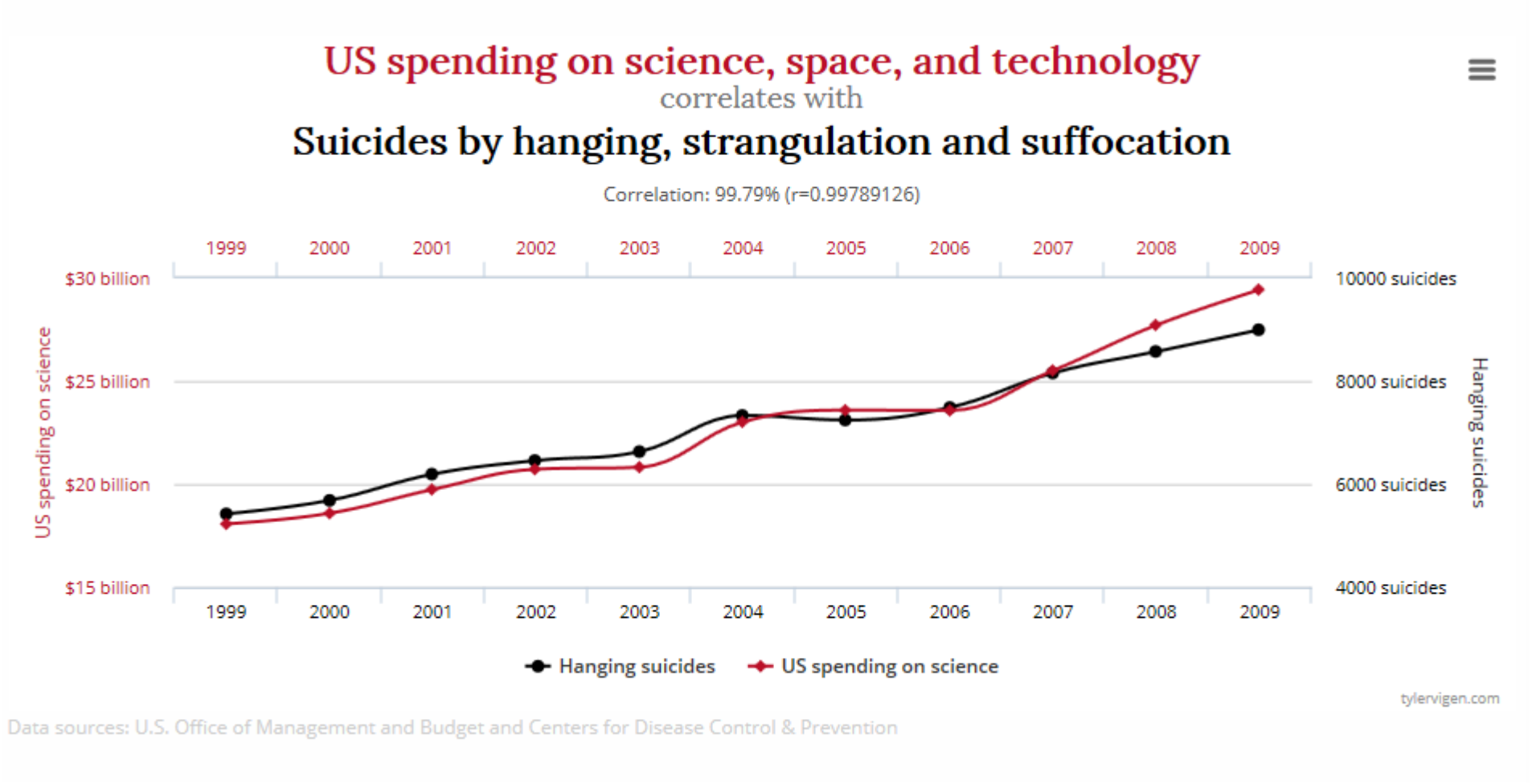
Myths & Challenges

Challenge 5 – Cause and effect

- *Cause and effect* is a relationship between events or things, where one is the result of the other or others.

Myths & Challenges

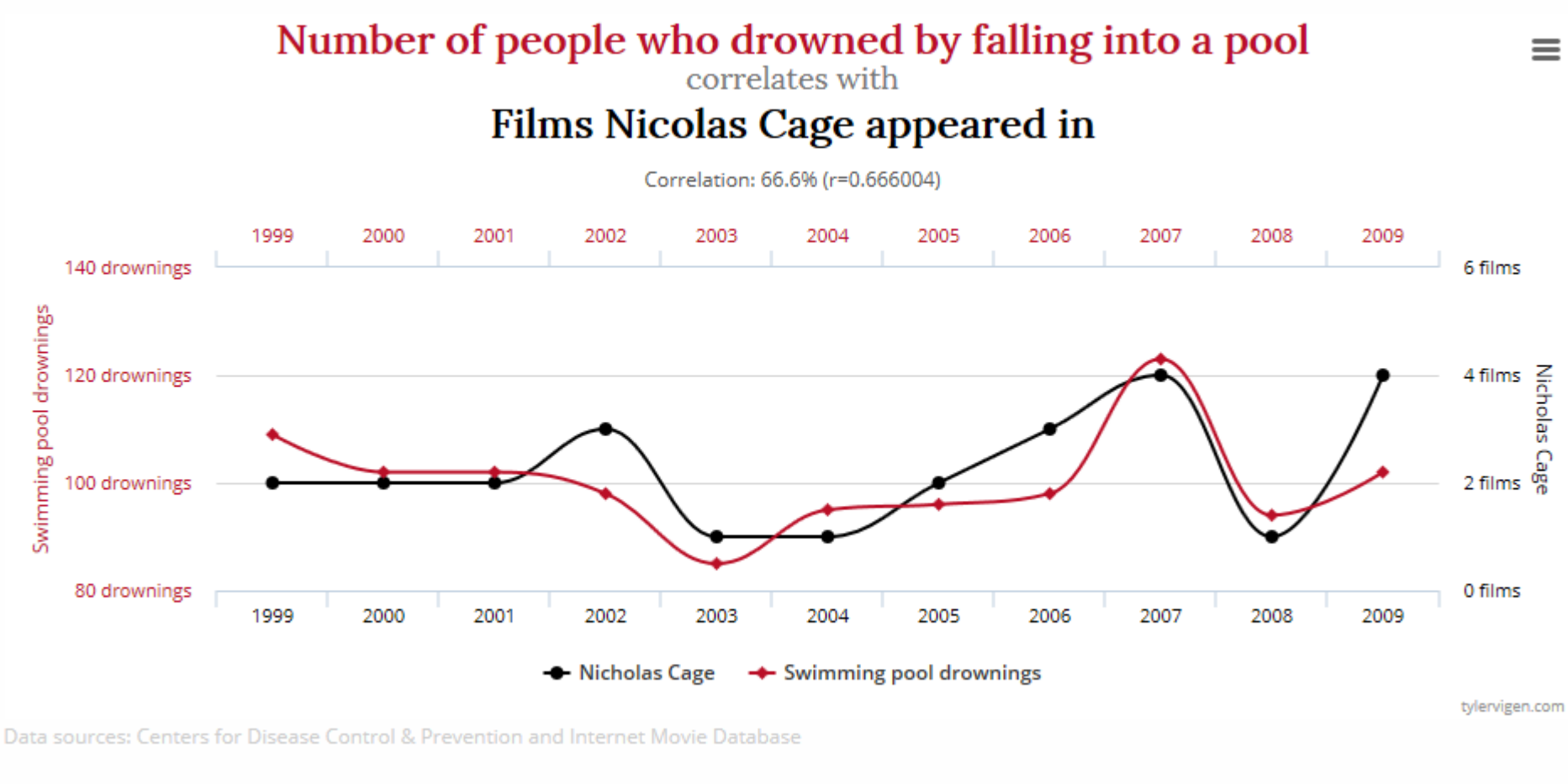
Challenge 5 – Cause and effect



http://tylervigen.com/spurious-correlations

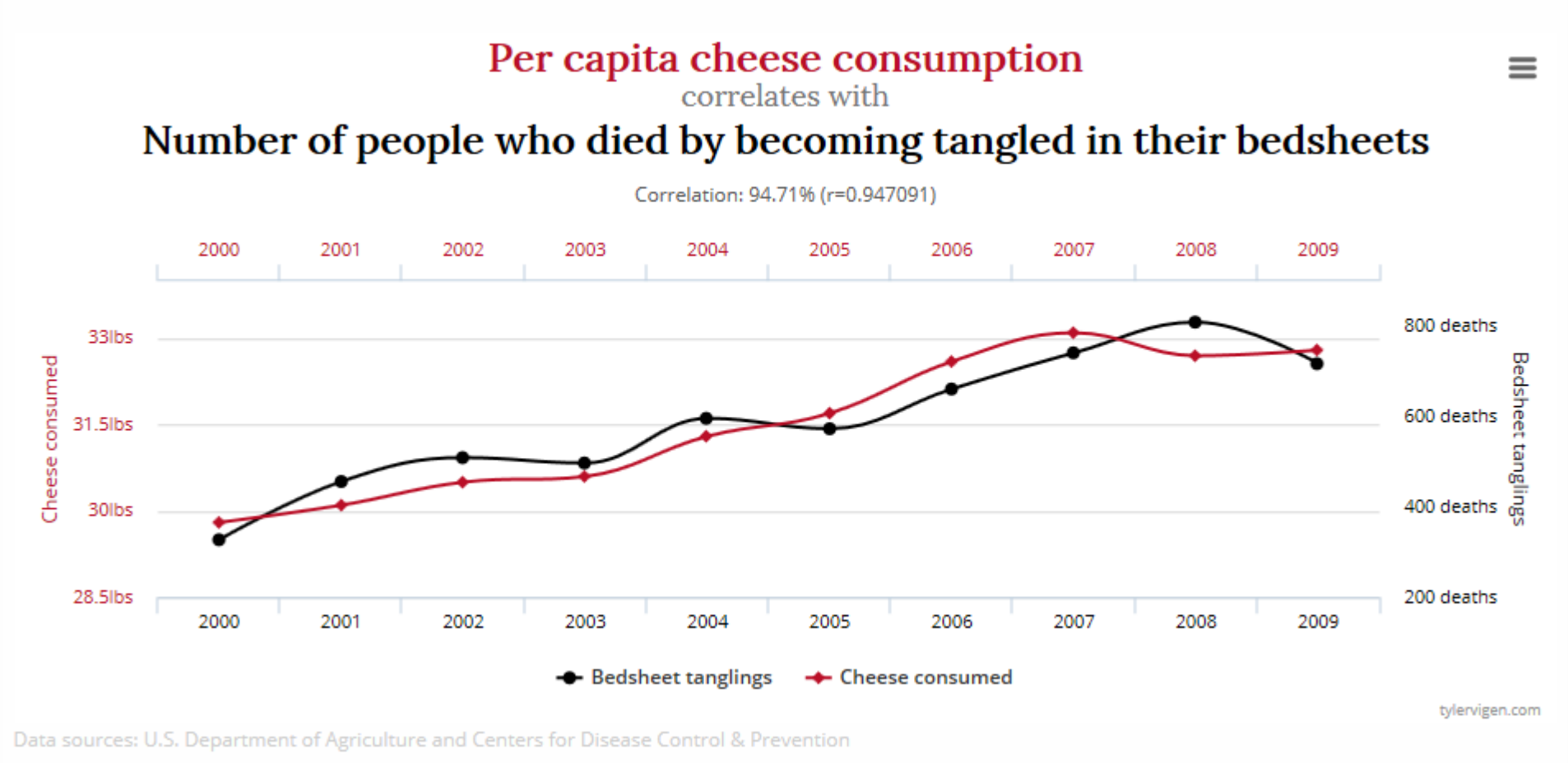
Myths & Challenges

Challenge 5 – Cause and effect



Myths & Challenges

Challenge 5 – Cause and effect



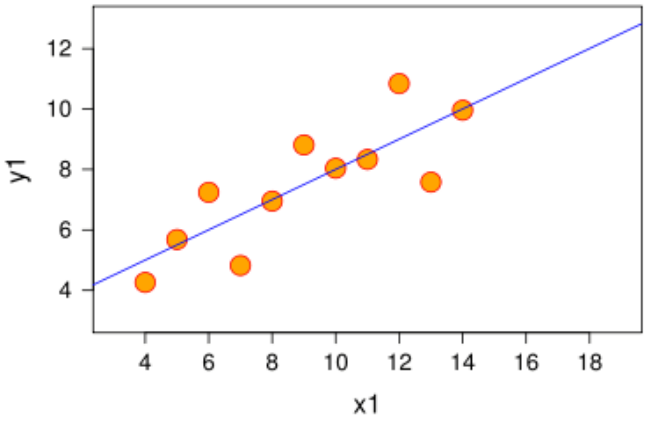
http://tylervigen.com/spurious-correlations

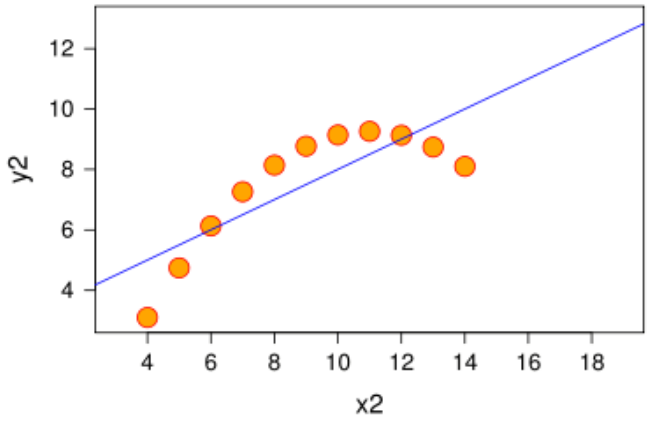
Myths & Challenges

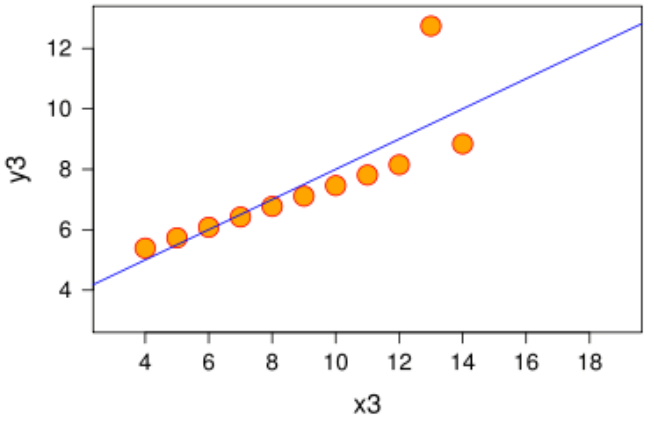
Challenge 6 – Do not forget the importance of data visualization

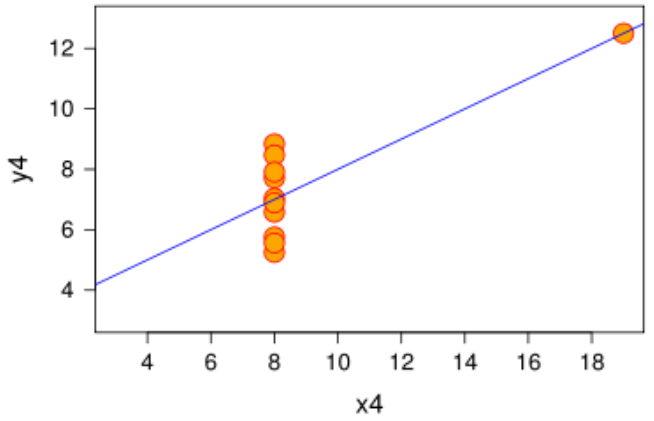
I		II		III		IV	
x	y	x	y	x	y	x	y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	19	12.5
12	10.84	12	9.13	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89

Property	Value
Mean of each x variable	9
Variance of each x variable	10
Mean of each y variable	7.5
Variance of each y variable	3.75
Correlation between each x and y variable	0.816
Linear regression line	y = 3 + 0.5x









Myths & Challenges

Remember…

- “Essentially, all models are wrong, but some are useful.”
- “Remember that all models are wrong: The practical question is how wrong do they have to be to not be useful.”

  George E. P. Box,
  1919 - 2013
  Professor Emeritus of Statistics at the University of Wisconsin

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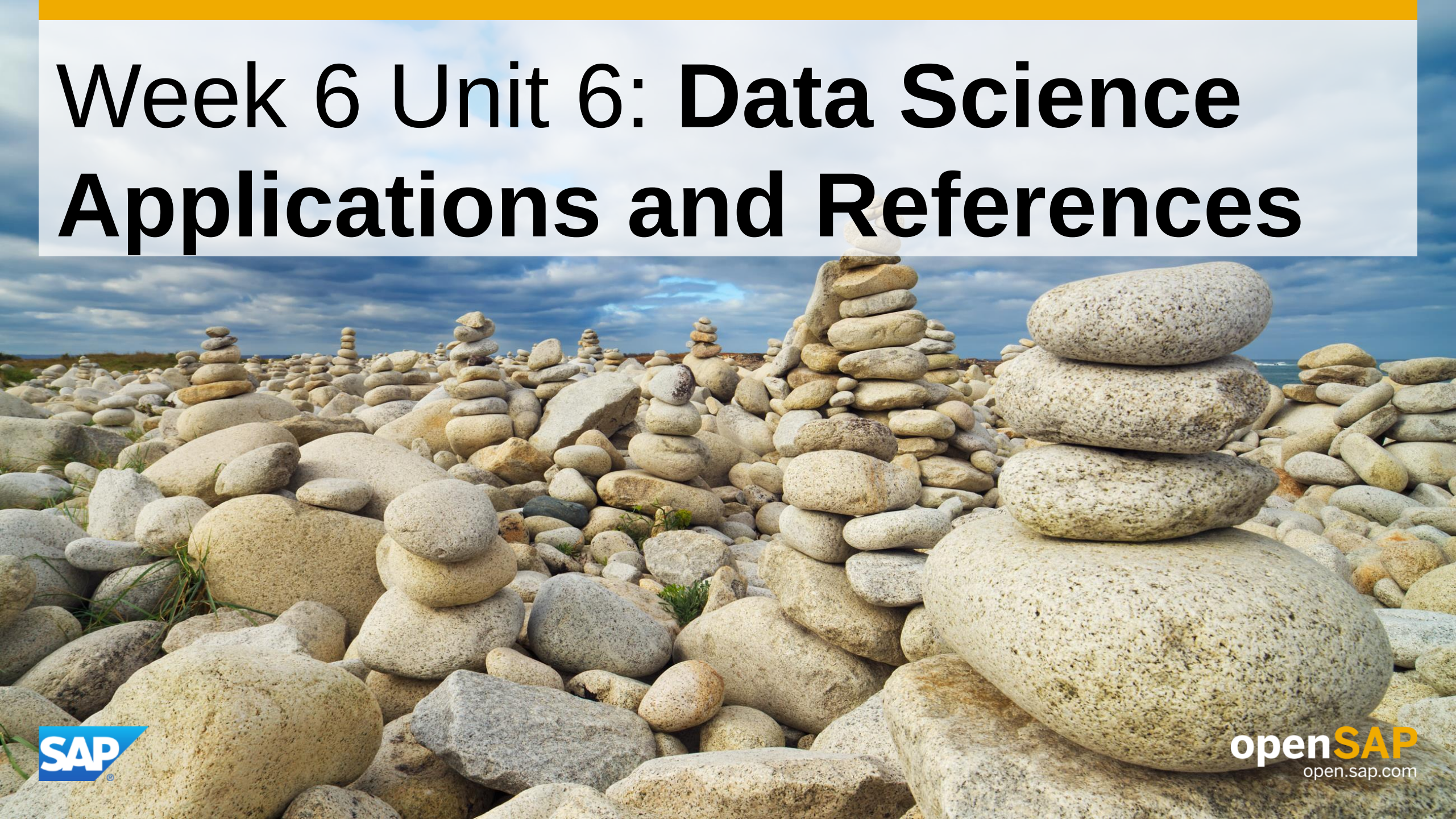
Week 6 Unit 6: **Data Science Applications and References**



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Data Science Applications and References

Applications of data science in SAP

SAP Hybris Marketing	Campaign optimisation, product recommendations, segmentation…
SAP Predictive Maintenance and Service	Anomaly detection, rule mining, survival analysis, failure prediction…
SAP Fraud Management	Anomaly detection, rule discovery
Unified Demand Forecast	Modeling and forecasting sales
SAP Integrated Business Planning	Demand sensing and multistage inventory optimization
SAP Digital Boardroom	Revenue forecasting
SAP Transportation Resource Planning	Resource optimisation allocation
SAP Assortment Planning for Retail	Optimization of product selection
SAP S/4HANA Finance	Cash management, liquidity forecast
SAP Real-Time Offer Management	Self-learning real-time recommendation engine
Big Data Analytics	Forecasting marketing opportunities, revenue, opportunity scoring…

Data Science Applications and References

Applications of data science by SAP customers

VELUX

VELUX: From Annual Plan to Rolling Forecasts with SAP® Business Planning and Consolidation powered by SAP HANA®

thélem assurances

Thélem assurances: Founding a Customer-Oriented Culture with SAP® Predictive Analytics

Covenant Transport

Covenant Transportation Group: Reducing Driver Turnover and Building a Safer Workforce with SAP® Predictive Analytics

EMS EMS-GRILTECH

Validating Sales Forecasts to Improve Production Planning with SAP® Predictive Analytics

"With SAP Predictive Analytics, we can better analyze sales demand forecasts and market fluctuations. This helps us meet our customer needs quickly without overstocking our inventory. The result is happier customers and lower costs – which is great news for our bottom line."

Tijani Ben Said, Manager Production Planning and Control, EMS-GRILTECH, EMS-CHEMIE AG

mBank

mBank: Delivering a Personalized Banking Experience for 4.5 Million Customers with SAP® Predictive Analytics

"SAP Predictive Analytics has allowed mBank to discover individual customer preferences and identify the next best activity for our marketing efforts. Now we are able to initiate more direct conversations, resulting in a better understanding of our clients on a personal level."

Bartosz Witorzenc, Strategic Initiatives Manager, Retail Banking Department, mBank S.A.

Data Science Applications and References

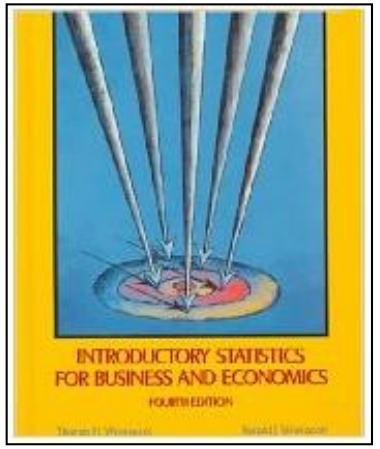
References – Statistics

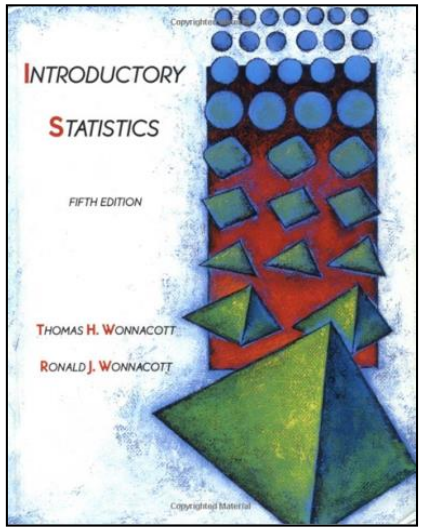
- Introductory Statistics For Business and Economics
  T.H. Wonnacott & R.J. Wonnacott

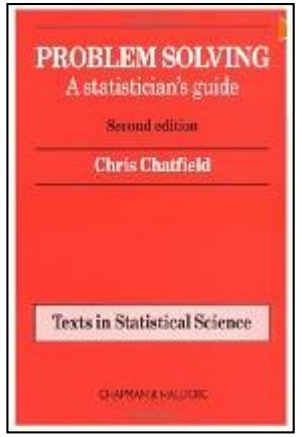
- Forecasting – Methods and Applications
  Makridakis, Wheelwright, & McGee

- Problem Solving: A Statistician's Guide
  Christopher Chatfield

- Introductory Statistics
  T.H. Wonnacott and R.J. Wonnacott

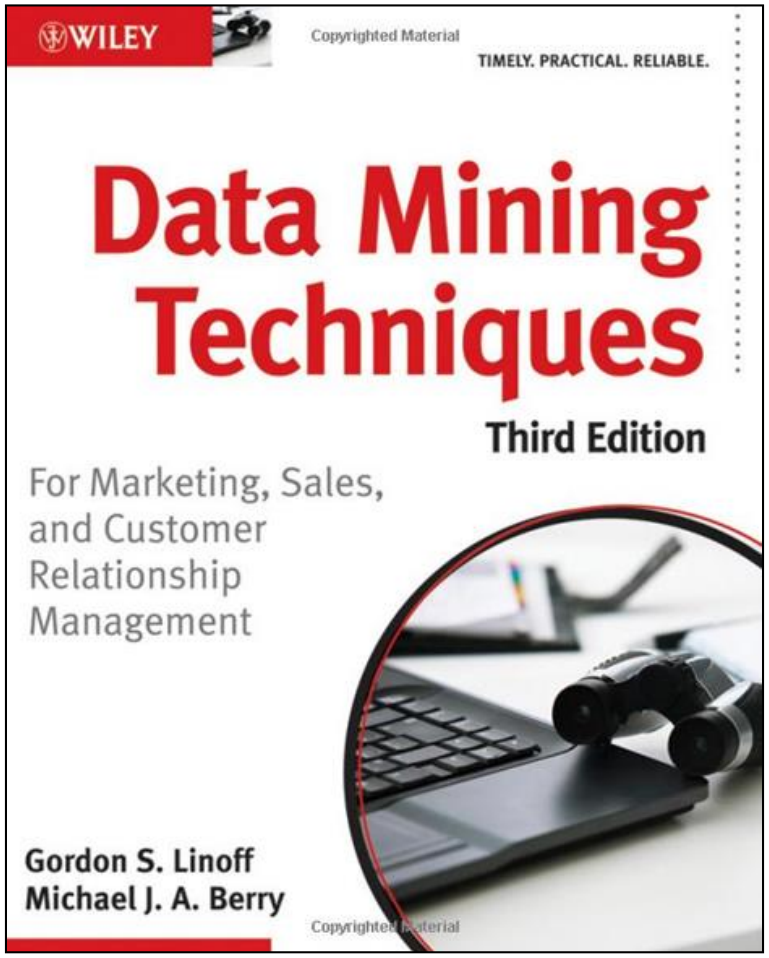


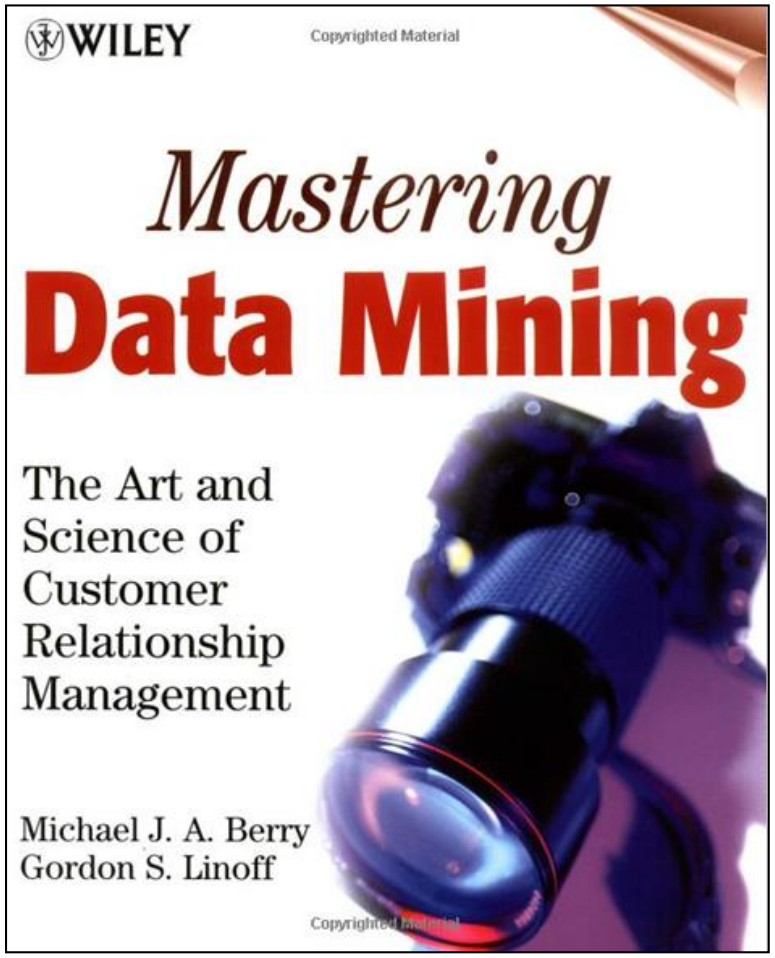


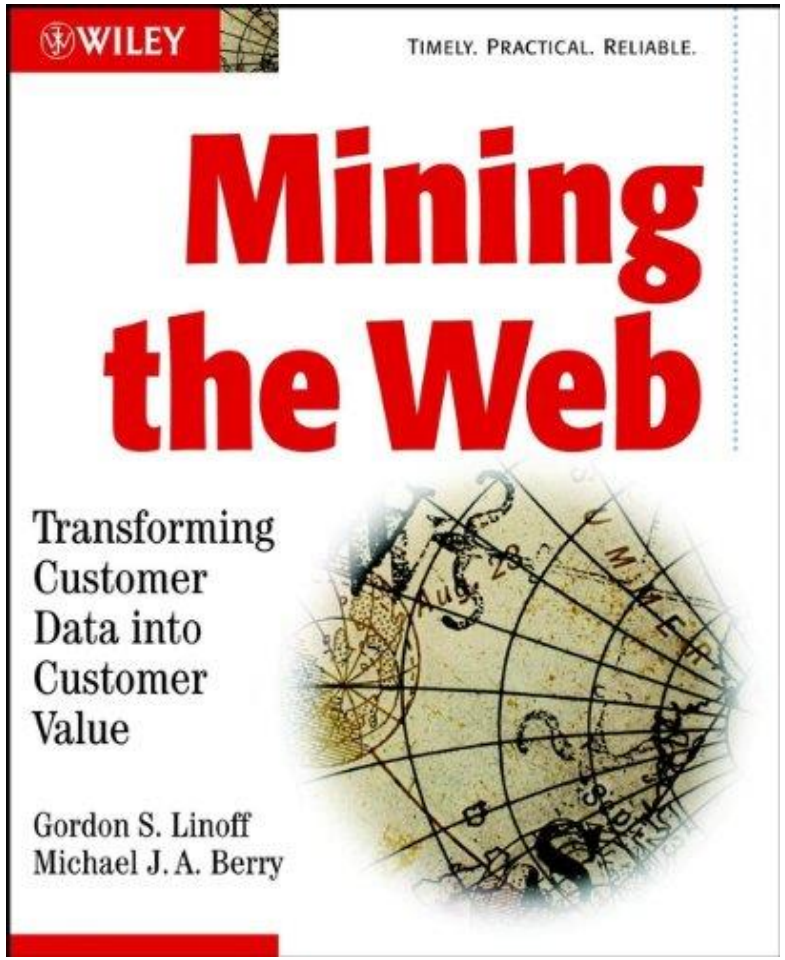


Data Science Applications and References

References – Data mining







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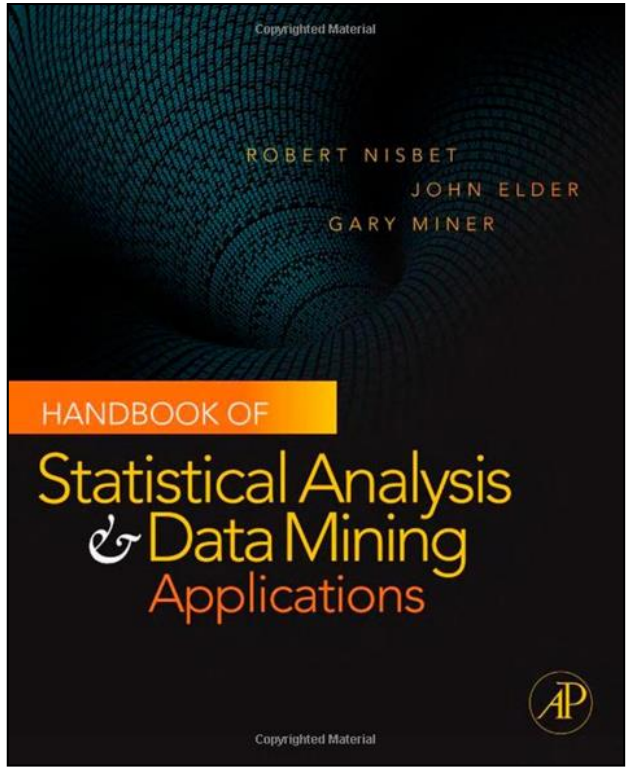
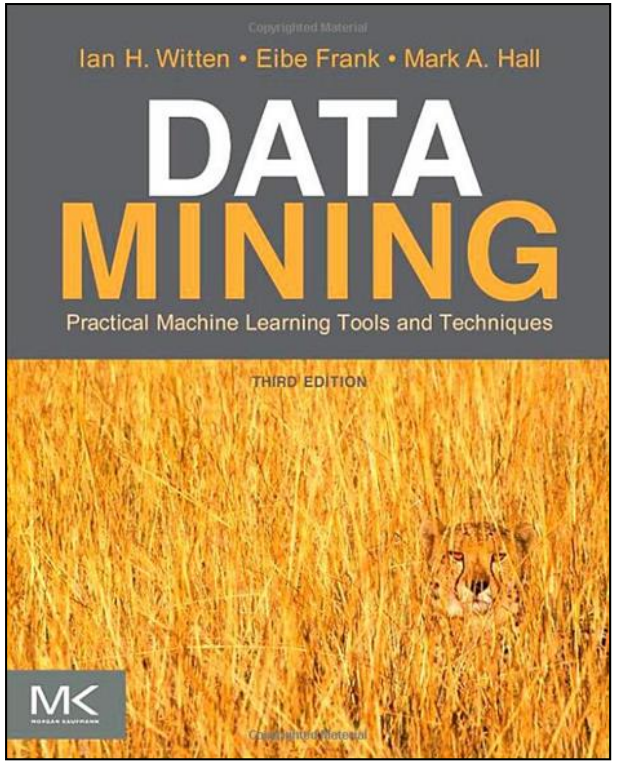
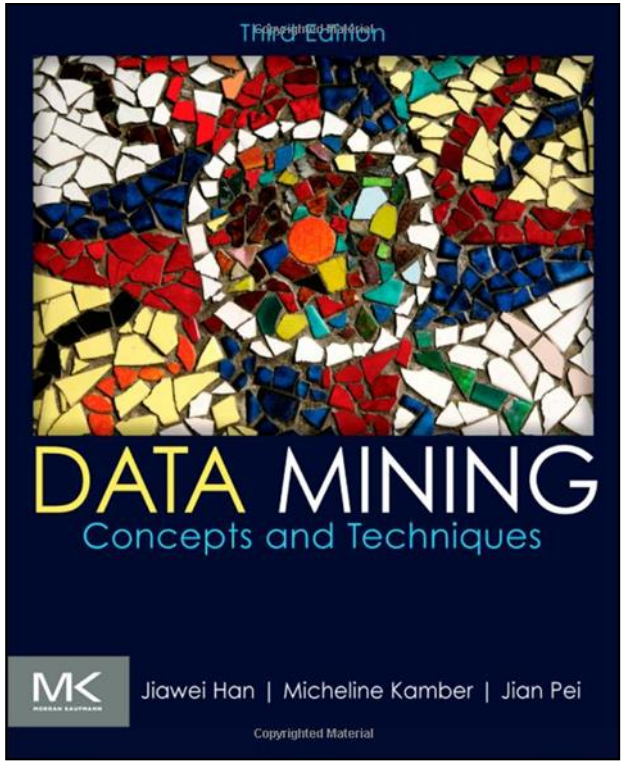
References – Data mining







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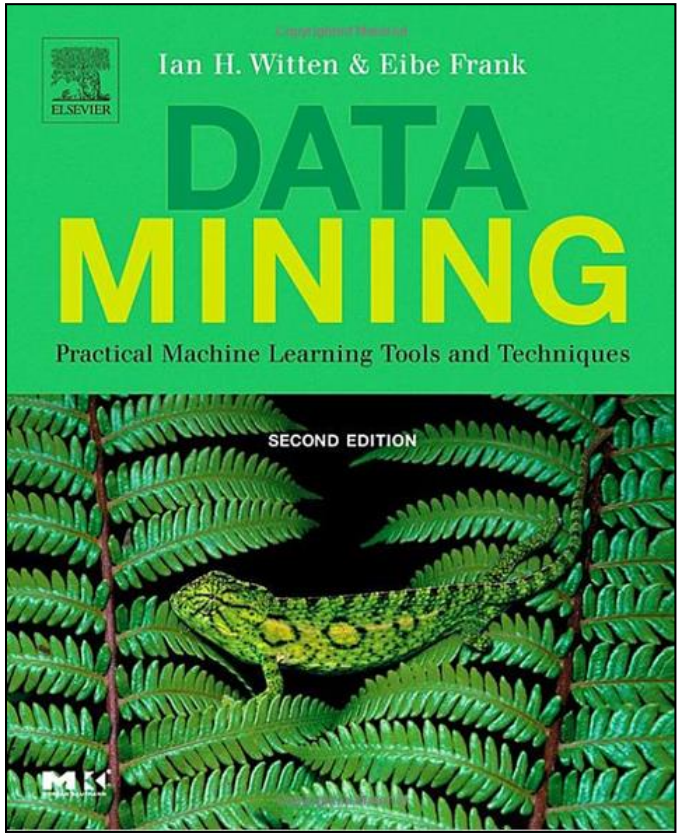

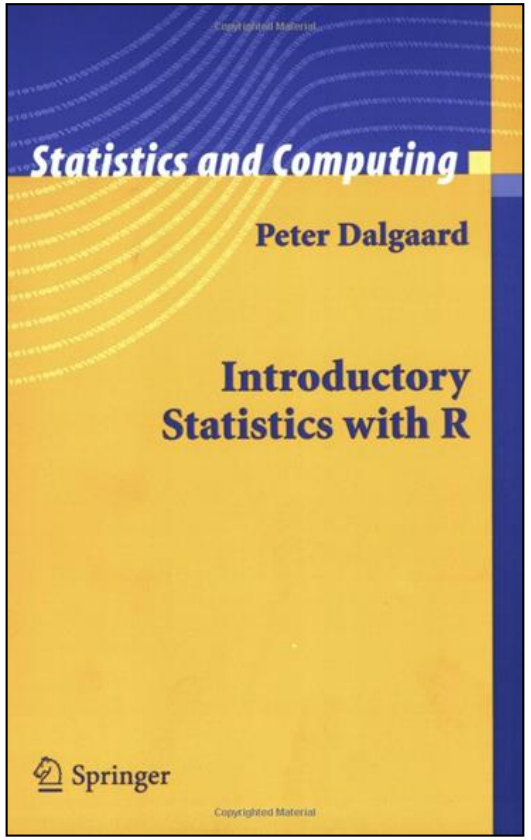

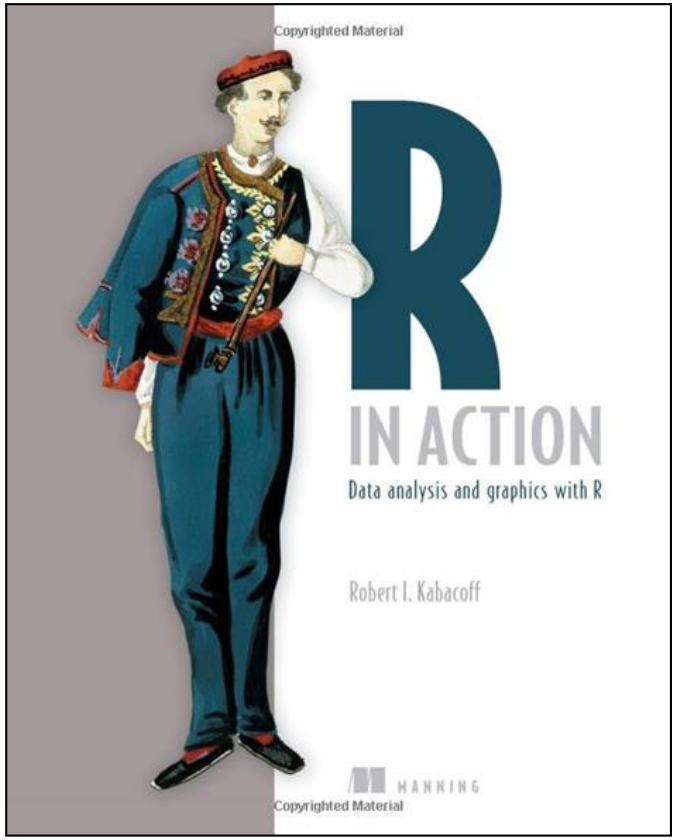

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- Roadmaps on SAP Service Marketplace
  - http://service.sap.com/saproadmaps
- SAP predictive analytics information and 30 day free trial
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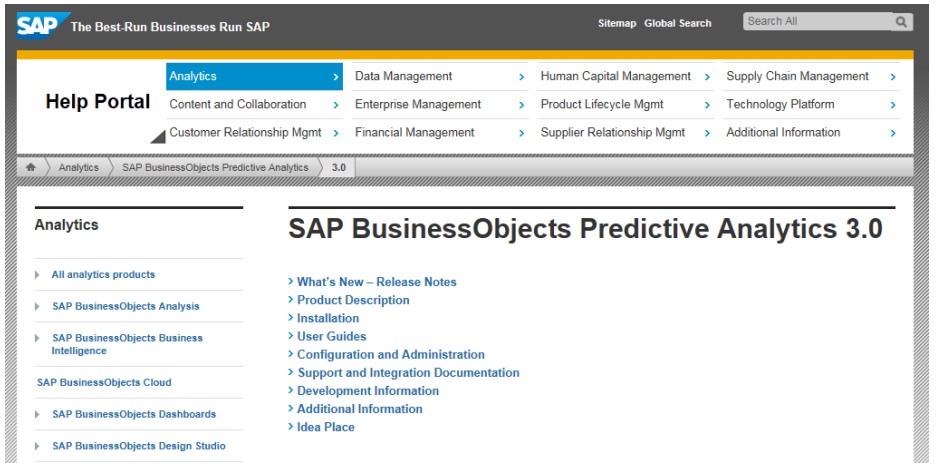

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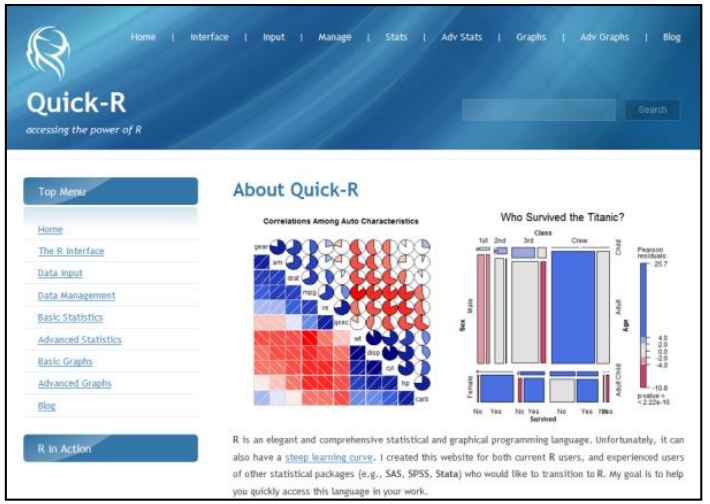
- The R manual - http://cran.r-project.org/doc/manuals/R-intro.html

- For beginners:
  - http://www.statmethods.net/
  - http://www.ats.ucla.edu/stat/R/
  - http://www.r-bloggers.com/
  - http://www.inside-r.org/r-resources-web



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References – Web resources

- KDnuggets
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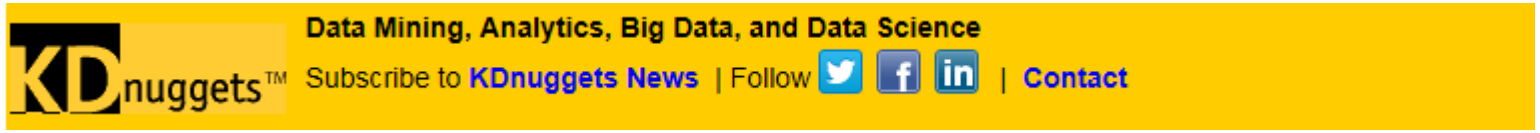

- Data Science Central
  - www.datasciencecentral.com/

- analyticbridge
  - www.analyticbridge.com/

- To learn more about PMML
  - http://dmg.org/

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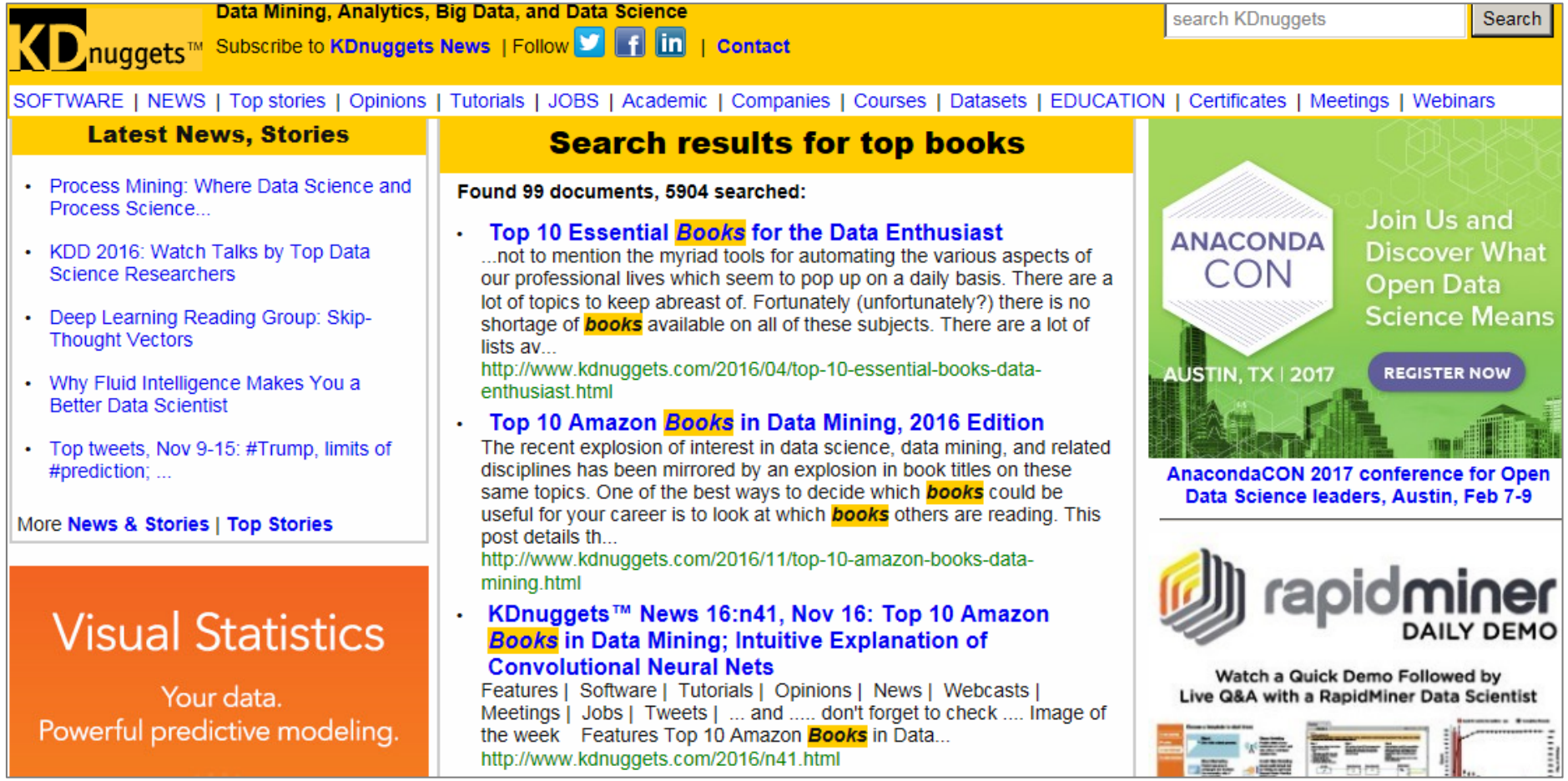
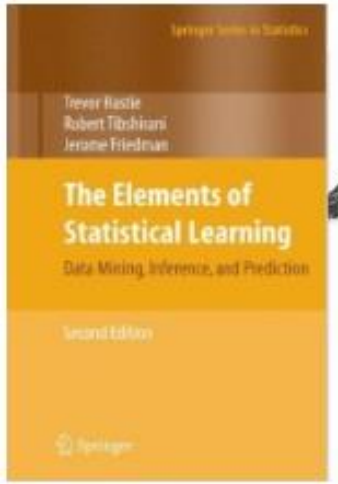
KDnuggets

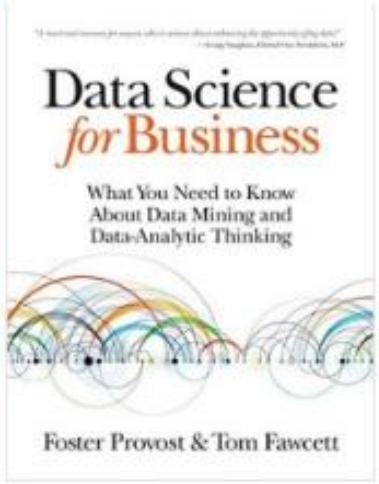


Data Science Applications and References

Top 10 books recommended by KDnuggets

1. **The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition**
   Trevor Hastie, Robert Tibshirani, Jerome Friedman
   4.1 out of 5 stars (78 reviews)
2. **Data Science from Scratch: First Principles with Python, 1st Edition**
   Joel Grus
   4.2 out of 5 stars (65 reviews)
3. **Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking, 1st Edition**
   Foster Provost, Tom Fawcett
   4.6 out of 5 stars (152 reviews)
4. **Data Analytics Made Accessible**
   Anil Maheshwari
   4.8 out of 5 stars (175 reviews)
5. **Python Machine Learning**
   Sebastian Raschka
   4.3 out of 5 stars (78 reviews)





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Top 10 books recommended by KDnuggets

6. **Data Smart: Using Data Science to Transform Information into Insight, 1st Edition**
John W. Foreman
4.7 out of 5 stars (105 reviews)

7. **Hadoop: The Definitive Guide, 4th Edition**
Tom White
4.6 out of 5 stars (41 reviews)

8. **R in Action: Data Analysis and Graphics with R, 2nd Edition**
Robert Kabacoff
4.8 out of 5 stars (33 reviews)

9. **Doing Data Science: Straight Talk from the Frontline, 1st Edition**
Cathy O'Neil, Rachel Schutt
4.0 out of 5 stars (50 reviews)

10. **Big Data: Principles and best practices of scalable realtime data systems, 1st Edition**
Nathan Marz, James Warren
4.4 out of 5 stars (33 reviews)

Thank you

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