Modelling with Impact:

What you need to know as an Analytics Professional

Craig Savage, PhD, MBA

Citizens Data Scientists - Melbourne

27 Feb, 2018

Introduction

- Share highlights of my experiences in accelerating algorithm development projects

  “Intelligence is learning from your mistakes, wisdom is learning from the mistakes of others.”

  “Wise men learn from others’ mistakes, fools from their own.”

Introduction

- Share highlights of my experiences in accelerating algorithm development projects

  “Intelligence is learning from your mistakes, wisdom is learning from the mistakes of others.”

  “Wise men learn from others’ mistakes, fools from their own.”

- Case study
  - Banking provisions under a new accounting standard (IFRS9)
  - Variety of tools required to solve effectively

Introduction

- Share highlights of my experiences in accelerating algorithm development projects

  “Intelligence is learning from your mistakes, wisdom is learning from the mistakes of others.”

  “Wise men learn from others’ mistakes, fools from their own.”

- Case study
  - Banking provisions under a new accounting standard (IFRS9)
  - Variety of tools required to solve effectively
- Highlights for “What you need to know as an Analytics Professional” throughout the talk.

Example problem: Implement IFRS9 Accounting Standard

- Introductions to….
  - Credit Risk
  - IFRS 9
- Modelling procedure
  - Data
  - Procedures
  - Review

Example problem:
Implement IFRS9 Accounting Standard

- Introductions to….
  - Credit Risk
  - IFRS 9
  - Review

Talk will be at a high level:
Majority of the talk will be Introduction!

Single-Slide Introduction: Credit Risk

- Loans are profitable when customers repay, lose money otherwise
  - *Provisions* are used to cover expected losses
  - Expected Credit Loss: $P_D \times LGD \times EAD$
  - *Collective Provisions* are allotted against all loans
  - *Specific Provisions* are raised against doubtful/impaired loans
  - In theory, Specific Provisions = Collective Provisions = Expected Credit Loss
  - Provisions count as an *Expense* (i.e. lowers profits)
- *Advanced Banks* maintain their own models for P_D, LGD, EAD
- A portfolio of loans is a *book* (e.g. mortgage book)
- A loan that increases in risk and recovers is said to *cure*.

Single-Slide Introduction: Credit Risk

- Loans are profitable when customers repay, lose money otherwise
  - *Provisions* are used to cover expected losses
  - Expected Credit Loss: $P_D \times LGD \times EAD$

Highly idealised case:
Single-Slide Introduction!

- *Advanced Banks* maintain their own models for P_D, LGD, EAD
- A portfolio of loans is a *book* (e.g. mortgage book)
- A loan that increases in risk and recovers is said to *cure*.

What you need to know as an Analytics Professional

- Business jargon is like a language
  - Easier to understand/read than speak/write
  - Similar to swearing – to use effectively, need a certain proficiency
- How to learn:
  - Internet (Blogs, Wikipedia)
  - LinkedIn for mentors in the area
- Three main reasons you'd be brought on:
  - Lack of capacity: They know what needs to be done, understand the complexity, don't have time.
  - Lack of capability: They have the time, but don't have the knowledge.

What you need to know as an Analytics Professional

- Business jargon is like a language
  - Easier to understand/read than speak/write

The Dreaded Both:

They have neither time nor knowledge

"Using Agile, we'll implement Machine Learning with Big Data on Azure to improve our NPS on Social Media with Millennials!"

  - Lack of capacity: They know what needs to be done, understand the complexity, don't have time.
  - Lack of capability: They have the time, but don't have the knowledge.

Few-Slide Introduction: IFRS9

- Summary of rules online
  - Powerpoint as Documentation

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2014

Project Summary

IFRS 9 *Financial Instruments*

IFRS

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2

Proje

IFR

Impairment

A forward-looking impairment model

Why is the IASB addressing impairment?

During the financial crisis, the delayed recognition of credit losses on loans (and other financial instruments) was identified as a weakness in existing accounting standards. Specifically, the existing model in IAS 39 (an 'incurred loss' model) delays the recognition of credit losses until there is evidence of a trigger event. This was designed to limit an entity's ability to create hidden reserves that can be used to flatter earnings during bad times.

As the financial crisis unfolded, it became clear that the incurred loss model gave room to a different kind of earnings management, namely to postpone losses. Even though IAS 39 did not require waiting for actual default before impairment is recognised, in practice this was often the case.

The complexity of IAS 39, which used multiple impairment models for financial instruments, was also identified as a concern.

How will the new requirements improve financial reporting?

The main objective of the new impairment requirements is to provide users of financial statements with more useful information about an entity's expected credit losses on financial instruments. The model requires an entity to recognise expected credit losses at all times and to update the amount of expected credit losses recognised at each reporting date to reflect changes in the credit risk of financial instruments.

This model is forward-looking and it eliminates the threshold for the recognition of expected credit losses, so that it is no longer necessary for a trigger event to have occurred before credit losses are recognised. Consequently, more timely information is required to be provided about expected credit losses.

Furthermore, when credit losses are measured in accordance with IAS 39, an entity may only consider those losses that arise from past events and current conditions. The effects of possible future credit loss events cannot be considered, even when they are expected. The requirements in IFRS 9 broaden the information that an entity is required to consider when determining its expectations of credit losses.

Specifically, IFRS 9 requires an entity to base its measurement of expected credit losses on reasonable and supportable information that is available without undue cost or effort, and that includes historical, current and forecast information.

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

"As the financial crisis unfolded, it became clear that the incurred loss model gave room to a different kind of earnings management, namely to postpone losses. Even though IAS 39 did not require waiting for actual default before impairment is recognised, in practice this was often the case."

July 2

…nt model

…ch used multiple
…cial instruments,
…rn.

…irements
…rting?

…y impairment
…ers of financial
…information about
…ses on financial
…ires an entity to
recognise expected credit losses at all times and to update the amount of expected credit losses recognised at each reporting date to reflect changes in the credit risk of financial instruments.

This model is forward-looking and it eliminates the threshold for the recognition of expected credit losses, so that it is no longer necessary for a trigger event to have occurred before credit losses are recognised. Consequently, more timely information is required to be provided about expected credit losses.

Furthermore, when credit losses are measured in accordance with IAS 39, an entity may only consider those losses that arise from past events and current conditions. The effects of possible future credit loss events cannot be considered, even when they are expected. The requirements in IFRS 9 broaden the information that an entity is required to consider when determining its expectations of credit losses.

Specifically, IFRS 9 requires an entity to base its measurement of expected credit losses on reasonable and supportable information that is available without undue cost or effort, and that includes historical, current and forecast information.

flatter earnings during bad times.

As the financial crisis unfolded, it became clear that the incurred loss model gave room to a different kind of earnings management, namely to postpone losses. Even though IAS 39 did not require waiting for actual default before impairment is recognised, in practice this was often the case.

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

"Furthermore, when credit losses are measured in accordance with IAS 39, an entity may only consider those losses that arise from past events and current conditions. The effects of possible future credit loss events cannot be considered, even when they are expected. The requirements in IFRS 9 broaden the information that an entity is required to consider when determining its expectations of credit losses. Specifically, IFRS 9 requires an entity to base its measurement of expected credit losses on reasonable and supportable information that is available without undue cost or effort, and that includes historical, current and forecast information."

Furthermore, when credit losses are measured in accordance with IAS 39, an entity may only consider those losses that arise from past events and current conditions. The effects of possible future credit loss events cannot be considered, even when they are expected. The requirements in IFRS 9 broaden the information that an entity is required to consider when determining its expectations of credit losses.

Specifically, IFRS 9 requires an entity to base its measurement of expected credit losses on reasonable and supportable information that is available without undue cost or effort, and that includes historical, current and forecast information.

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2

Proje

IFR

Impai

A f

Why i
impai

During
recogni
other fi
a weak
Specific
'incurr
credit l
event. T
to creat
flatter e

As the f
clear th
to a diff
namely
did not
impairr
often th

14 |

Impairment

Overview of the impairment requirements

What are the stages?

Stage 1

As soon as a financial instrument is originated or purchased, 12-month expected credit losses are recognised in profit or loss and a loss allowance is established.

This serves as a proxy for the initial expectations of credit losses.

For financial assets, interest revenue is calculated on the gross carrying amount (ie without adjustment for expected credit losses).

Stage 2

If the credit risk increases significantly **and** the resulting credit quality is not considered to be low credit risk, full lifetime expected credit losses are recognised.

Lifetime expected credit losses are only recognised if the credit risk increases significantly from when the entity originates or purchases the financial instrument.

The calculation of interest revenue on financial assets remains the same as for Stage 1.

Stage 3

If the credit risk of a financial asset increases to the point that it is considered credit-impaired, interest revenue is calculated based on the amortised cost (ie the gross carrying amount adjusted for the loss allowance). Financial assets in this stage will generally be individually assessed.

Lifetime expected credit losses are still recognised on these financial assets.

16 | IFRS 9 Financial Instruments | July 2014

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2

Proje

IFR

Impai

A f

Why i
impai

During
recogni
other fi
a weak
Specific
'incurr
credit l
event. T
to creat
flatter e

As the f
clear th
to a diff
namely
did not
impairr
often th

14 |

Impairment

Overview of the impairment requirements

What are the stages?

Stage 1

As soon as a financial instrum originated or purchased, expected credit losses are reco in profit or loss and a loss allowa is established.

This is a proxy for the initial expectations of credit losses.

For financial assets, int is calculated on the gross carrying amount (ie without adj for expected credit loss

Stage 2

If the credit risk increases significantly **and** the resulting credit quality is not considered to be low credit risk, full lifetime expected credit losses are recognised.

Lifetime expected credit losses are only recognised if the credit risk increases significantly from when the entity originates or purchases the financial instrument.

The calculation of interest revenue on financial assets remains the same as for Stage 1.

Stage 3

If the credit risk of a financial a increases to the point t considered credit-im interest revenue is calcula on the amortised co loss carrying amount for the loss allow Financial assets in this stage wi be ind ally assessed.

Lifetime expected c losses are still recognised on financial assets.

Collective Provisions

Specific Provisions

16 | IFRS 9 Financial Instruments | July 2014

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2

Proje

IFR

Impai

A f

Why i
impai

During
recogni
other fi
a weak
Specific
'incurr
credit l
event. T
to creat
flatter e

As the f
clear th
to a diff
namely
did not
impairr
often th

14 |

Impairment

Overview

"If the credit risk increases significantly and the resulting credit quality is not considered to be low credit risk, full lifetime expected credit losses are recognised."

Stage 1	Stage 2	Stage 3
As soon as a financial instrument is originated or purchased, 12-month expected credit losses are recognised in profit or loss and a loss allowance is established. This serves as a proxy for the initial expectations of credit losses. For financial assets, interest revenue is calculated on the gross carrying amount (ie without adjustment for expected credit losses).	If the credit risk increases significantly **and** the resulting credit quality is not considered to be low credit risk, full lifetime expected credit losses are recognised. Lifetime expected credit losses are only recognised if the credit risk increases significantly from when the entity originates or purchases the financial instrument. The calculation of interest revenue on financial assets remains the same as for Stage 1.	If the credit risk of a financial asset increases to the point that it is considered credit-impaired, interest revenue is calculated based on the amortised cost (ie the gross carrying amount adjusted for the loss allowance). Financial assets in this stage will generally be individually assessed. Lifetime expected credit losses are still recognised on these financial assets.

16 | IFRS 9 Financial Instruments | July 2014

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2

Proje

IFR

Impa

A

Why
impa

During
recogn
other
a weal
Specif
'incur
credit
event.
to crea
flatter

As the
clear t
to a di
namel
did no
impai
often

14 |

Impairment

Overvie

As soon as a fina
originated or pu
credit losses are
and a loss allowa

This serves as a p
expectations of c

For financial asse
calculated on the
(ie without adjus
credit losses).

16 | IFRS 9 Financial Instru

Impairment

Measuring expected credit losses

What should an entity consider when measuring expected credit losses?

Credit losses are the present value of all cash shortfalls. Expected credit losses are an estimate of credit losses over the life of the financial instrument. When measuring expected credit losses, an entity should consider:

(a) the probability-weighted outcome: expected credit losses should represent neither a best or worst-case scenario. Rather, the estimate should reflect the possibility that a credit loss occurs and the possibility that no credit loss occurs;

(b) the time value of money: expected credit losses should be discounted to the reporting date; and

(c) reasonable and supportable information that is available without undue cost or effort.

What information is used?

An entity is required to use reasonable and supportable information that is available at the reporting date without undue cost or effort, and that includes information about past events, current conditions and forecasts of future conditions.

IFRS 9 does not prescribe particular measurement methods. Also, an entity may use various sources of data that may be internal (entity-specific) and external.

Entities are not required to use a 'crystal ball' to predict the future; what an entity uses depends on the availability of information. As the forecast horizon increases, it is expected that the specificity of information used to measure expected credit losses will decrease. (For example, rather than estimating specific cash flow shortfalls it may be necessary to consider information such as historical loss rates adjusted as relevant for current and forecast conditions).

Although the model is forward-looking, historical information is always considered to be an important anchor or base from which to measure expected credit losses. However, historical data should be adjusted on the basis of current observable data to reflect the effects of current conditions and forecasts of future conditions.

IFRS 9 Financial Instruments | July 2014 | 19

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

"Credit losses are the present value of all cash shortfalls. When measuring expected credit losses, an entity should consider:

(a) the probability-weighted outcome: expected credit losses should represent neither a best or worst-case scenario. Rather the estimate should reflect the possibility that a credit loss occurs and the possibility that no credit loss occurs;

(b) the time value of money: expected credit losses should be discounted to the reporting date;

…"

Impairment

Measuring expected credit losses

What should an entity consider when measuring expected credit losses?

Credit losses are the present value of all cash shortfalls. Expected credit losses are an estimate of credit losses over the life of the financial instrument. When measuring expected credit losses, an entity should consider:

(a) the probability-weighted outcome: expected credit losses should represent neither a best or worst-case scenario. Rather, the estimate should reflect the possibility that a credit loss occurs and the possibility that no credit loss occurs;

(b) the time value of money: expected credit losses should be discounted to the reporting date; and

(c) reasonable and supportable information that is available without undue cost or effort.

What information is used?

An entity is required to use reasonable and supportable information that is available at the reporting date without undue cost or effort, and that includes information about past events, current conditions and forecasts of future conditions.

IFRS 9 does not prescribe particular measurement methods. Also, an entity may use various sources of data that may be internal (entity-specific) and external.

Entities are not required to use a 'crystal ball' to predict the future; what an entity uses depends on the availability of information. As the forecast horizon increases, it is expected that the specificity of information used to measure expected credit losses will decrease. (For example, rather than estimating specific cash flow shortfalls it may be necessary to consider information such as historical loss rates adjusted as relevant for current and forecast conditions).

Although the model is forward-looking, historical information is always considered to be an important anchor or base from which to measure expected credit losses. However, historical data should be adjusted on the basis of current observable data to reflect the effects of current conditions and forecasts of future conditions.

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

July 2

Proje

IFR

Impa

A

Why
impa

During
recogn
other
a weal
Specif
'incur
credit
event.
to crea
flatter

As the
clear t
to a di
namel
did no
impai
often

14 |

Impairment

Overvie

As soon as a fina
originated or pu
credit losses are
and a loss allowa

This serves as a p
expectations of c

For financial asse
calculated on the
(ie without adjus
credit losses).

16 | IFRS 9 Financial Instru

Impairment

Measuring expected credit losses

What should an entity consider when measuring expected credit losses?

Credit losses are the present value of all cash shortfalls. Expected credit losses are an estimate of credit losses over the life of the financial instrument. When measuring expected credit losses, an entity should consider:

(a) the probability-weighted outcome: expected credit losses should represent neither a best or worst-case scenario. Rather, the estimate should reflect the possibility that a credit loss occurs and the possibility that no credit loss occurs;

What information is used?

An entity is required to use reasonable and supportable information that is available at the reporting date without undue cost or effort, and that includes information about past events, current conditions and forecasts of future conditions.

IFRS 9 does not prescribe particular measurement methods. Also, an entity may use various sources of data that may be internal (entity-specific) and external.

Entities are not required to use a 'crystal ball' to predict the future; what an entity uses depends on the availability of information. As the forecast horizon increases, it is expected that the specificity of information used to measure expected credit losses will decrease. (For example, rather than estimating specific cash flow shortfalls it may be necessary to consider information such as historical loss rates adjusted as relevant for current and forecast conditions).

Although the model is forward-looking, historical information is always considered to be an important anchor or base from which to measure expected credit losses. However, historical data should be adjusted on the basis of current observable data to reflect the effects of current conditions and forecasts of future conditions.

"IFRS 9 does not prescribe particular measurement methods. Also, an entity may use various sources of data that may be internal (entity-specific) and external."

IFRS 9 Financial Instruments | July 2014 | 19

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

Few-Slide Introduction: IFRS9

"Entities are not required to use a 'crystal ball' to predict the future; what an entity uses depends on the availability of information. As the forecast horizon increases, it is expected that the specificity of information used to measure expected credit losses will decrease. …
Although the model is forward-looking, historical information is always considered to be an important anchor or base from which to measure expected credit losses. However, historical data should be adjusted on the basis of current observable data to reflect the effects of current conditions and forecasts of future conditions."

Entities are not required to use a 'crystal ball' to predict the future; what an entity uses depends on the availability of information. As the forecast horizon increases, it is expected that the specificity of information used to measure expected credit losses will decrease. (For example, rather than estimating specific cash flow shortfalls it may be necessary to consider information such as historical loss rates adjusted as relevant for current and forecast conditions).

Although the model is forward-looking, historical information is always considered to be an important anchor or base from which to measure expected credit losses. However, historical data should be adjusted on the basis of current observable data to reflect the effects of current conditions and forecasts of future conditions.

19

http://archive.ifrs.org/Current-Projects/IASB-Projects/Financial-Instruments-A-Replacement-of-IAS-39-Financial-Instruments-Recognitio/Documents/IFRS-9-Project-Summary-July-2014.pdf

What you need to know as an Analytics Professional

- Learn about your business area
- Make a checklist of requirements for your solution:
  - Data: "*…reasonable and supportable information that is available without undue cost or effort*"
  - Time value of money – need a discount rate.
  - Need to classify Stage 1, Stage 2, Stage 3.
  - Need to forecast economic conditions
  - Migration between stages
  - No requirements on algorithms, types, etc.
    - Must be fun to audit!
    - Ask 10 analysts, get 10 different solutions

Data

"… reasonable and supportable information that is available without undue cost or effort"

Data

- Banking key metrics available from the Australian Prudential Regulatory Authority (APRA)

Data

- Banking ke… …rudential Regulatory…

Data

- Banking ke… …rudential Regulatory…

St

Qua

Septeml

Copyright

Disclaimer

While APRA endeavours to ensure the quality of this publication, APRA does not accept any responsibility for the accuracy, completeness or currency of the material included in this publication, and will not be liable for any loss or damage arising out of any use of, or reliance on, this publication.

Revisions

This edition of the publication may contain revisions to previously published statistics. Significant revisions, if any, are identified and quantified in the 'Important notice'.

This publication includes revisions to previously published statistics if better source data are available or if compilation errors are uncovered.

APRA regularly analyses past revisions to identify potential improvements to the source data and statistical compilation techniques, in order to minimise the frequency and scale of any future revisions.

Forthcoming issues

This publication will be released according to the timetable published on the APRA website.

Notation

Amounts are expressed in millions of Australian dollars. Both the Australian-dollar denominated transactions and the Australian-dollar equivalent of foreign-currency denominated transactions are included.

The symbol '*' indicates that the data have been masked to maintain confidentiality.

The blank cells represent items that are not applicable, for example where data were collected up to or from a certain period end date.

Glossary and explanatory notes

A set of explanatory notes is provided at the end of the publication to assist the reader in understanding the source and definitions of the data. In particular, these notes help explain differences between the data presented and information publicly released by banks in their financial statements and profit

Data

- B
  R

Copyright

© Australian Prudential Regulation Authority (APRA)

This work is licensed under the Creative Commons Attribution 3.0 Australia Licence (CCBY 3.0).

This licence allows you to copy, distribute and adapt this work, provided you attribute the work and do not suggest that APRA endorses you or your work. To view a full copy of the terms of this licence, visit:

http://creativecommons.org/licenses/by/3.0/au/

Thanks to APRA for making the data freely available. I acknowledge their copyright to the data.

I have no affiliation with APRA.

Although I'm using their data, that should not be construed as their endorsement of my work.

Glossary and explanatory notes

A set of explanatory notes is provided at the end of the publication to assist the reader in understanding the source and definitions of the data. In particular, these notes help explain differences between the data presented and information publicly released by banks in their financial statements and profit

Data

Table 5d Major banks' asset quality

($ million, consolidated

	Jun 2004	Sep 2004	Dec 2004	Mar 2005	Jun 2005	Sep 2005	Dec 2005	Mar 2006	Jun 2006	Sep 2006	Dec 2006	Mar 2007	Jun 2007	Sep 2007	Dec 2007	Mar 2008	Jun 2008	Sep 2008	Dec 2008	Mar 2009	Jun 2009	Sep 2009	Dec 2009	Mar 2010	Jun 2010
Impaired facilities																									
Non-accrual items with provisions	2,319	2,231	2,133	2,011	1,997	1,869	1,828	1,975	1,823	1,588	1,683	1,749				3,683	4,482	5,533	10,809	13,896	17,113	16,836	17,908	19,476	20,162
Non-accrual items without provisions	940	718	677	708	691	664	739	604	570	729	772	612				720	364	437	1,019	830	880	879	966	1,264	1,483
Restructured items with provisions	175	171	124	152	144	67	25	23	21	21	18	17	15			0	0	1	1	1	73	72	97	102	66
Restructured items without provisions	2	73	73	32	51	34	6	6	6	3	2	2	4				57	852	11	251	300	1,449	1,314	1,514	1,440
Other real estate owned	0	0	0	0	0	0	0	0	0	0	0	0	0				0	7	6	6	11	6	6	9	30
Other assets acquired through security enforcement	0	5	3	2	1	0	0	0	1	0	0	0	0				0	0	0	0	0	0	0	0	0
Total impaired facilities	**3,435**	**3,198**	**3,011**	**2,905**	**2,885**	**2,634**	**2,597**	**2,607**	**2,420**	**2,340**	**2,475**	**2,380**	**2,599**	**2,820**				**6,829**	**11,846**	**14,985**	**18,377**	**19,241**	**20,291**	**22,365**	**23,180**
of which: Facilities in Australia	1,806	1,852	1,959	2,051	2,040	1,864	1,988	2,037	1,900	1,861	2,057	1,944	2,157	2,173				5,060	9,209	11,463	13,202	13,886	14,902	16,227	16,310
Provisions held																									
Specific provisions	1,345	1,341											952	968	1,094				4,339	5,753	6,925	6,381	6,741	7,330	7,483
Security held	1,555	1,495											231	1,378	1,309				4,387	5,876	7,116	8,936	9,901	11,964	13,115
Total provisions held	**2,900**	**2,837**											**182**	**2,347**	**2,403**	**3,54**			**,726**	**11,628**	**14,041**	**15,317**	**16,642**	**19,294**	**20,599**
of which: Facilities in Australia	1,845	1,745											733	1,754	1,743	2,810			63	9,311	10,766	11,583	12,301	14,571	14,677
Past due items	**1,963**	**2,263**											**719**	**3,448**	**3,409**	**3,893**	**4,**			**8,010**	**8,733**	**8,503**	**9,203**	**9,490**	**10,516**
of which: Facilities in Australia	1,659	1,976											107	2,789	2,744	3,042	3,572			195	6,734	6,727	7,460	7,944	8,859
Sum of impaired facilities and past due items	5,398	5,461	5,258	5,540	5,507	5,158	5,264	5,692	5,836	5,489	5,735	6,353	6,319	6,268	6,328	8,304	9,311				27,109	27,745	29,494	31,855	33,697
Gross loans and advances	**811,907**	**830,550**	**857**										**862**	**1,138,439**	**1,209,122**	**1,242,889**	**1,278,885**	**1,335,701**			**36**	**1,574,473**	**1,588,756**	**1,606,758**	**1,659,038**
Impaired facilities to loans and advances	**0.4%**	**0.4%**											**.2%**	**0.2%**	**0.2%**	**0.4%**	**0.4%**	**0.5%**				**1.2%**	**1.3%**	**1.4%**	**1.4%**
Past due to loans and advances	**0.2%**	**0.3%**											**.3%**	**0.3%**	**0.3%**	**0.3%**	**0.3%**	**0.4%**				**0.5%**	**0.6%**	**0.6%**	**0.6%**
Specific provisions to impaired facilities	**39.1%**	**41.9%**	**43.1%**	**43.1%**	**42.1%**	**39.3%**	**37.0%**	**39.0%**	**39.0%**	**38.0%**	**38.4%**	**39.0%**	**36.6%**	**34.3%**	**37.5%**	**40.1%**	**42.0%**	**34.6%**				**33.2%**	**33.2%**	**32.8%**	**32.3%**
Specific provisions and security held to impaired facilities	**84.4%**	**88.7%**	**89.1%**	**91.7%**	**88.5%**	**85.6%**	**80.4%**	**86.3%**	**85.3%**	**89.4%**	**91.0%**	**89.5%**	**84.0%**	**83.2%**	**82.3%**	**80.4%**	**81.6%**	**74.2%**				**79.6%**	**82.0%**	**86.3%**	**88.9%**
Number of entities							4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Impaired facilities to loans and advances: Stage 3

Specific Provisions to impaired facilities: LGD (about 40%)

Pillar Banks

Past due to loans and advances: Stage 2

ory notes

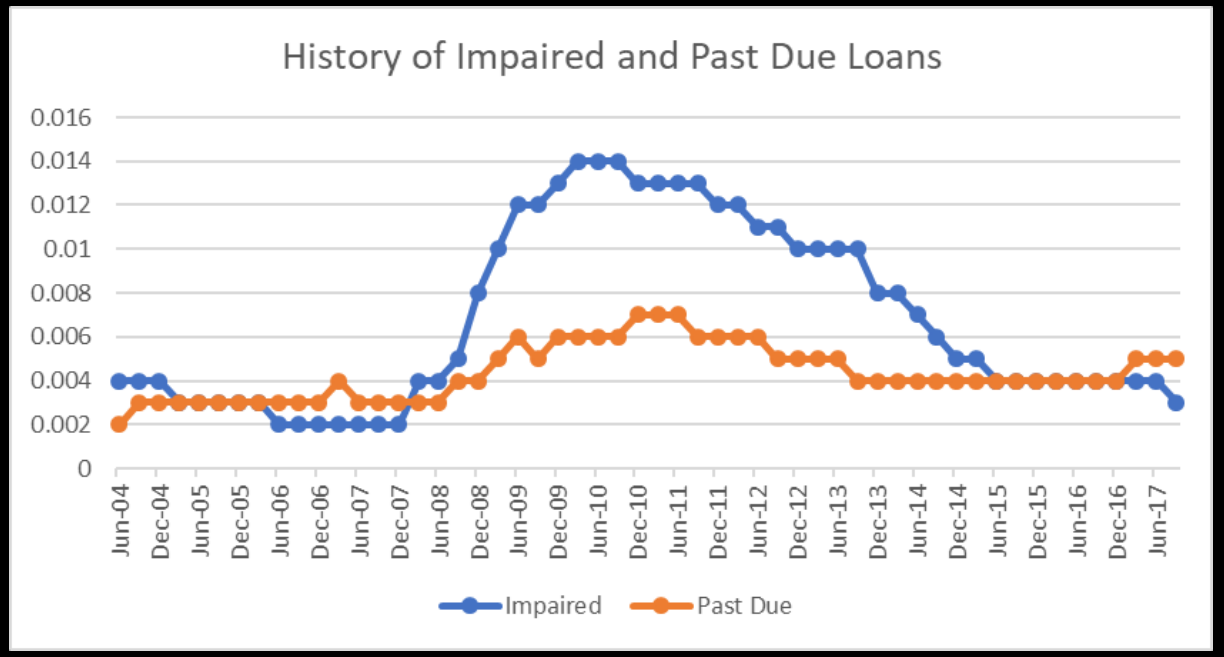
provided at the end of the publication to assist the reader in understanding the data. In particular, these notes help explain differences between the on publicly released by banks in their financial statements and profit

Data Visualisation: Target Variables

- Visual representation of data
  - Trends, periods, outliers
- How you present matters
  - Graph types
  - Graph theme
- Visualisations demonstrate your Tribe

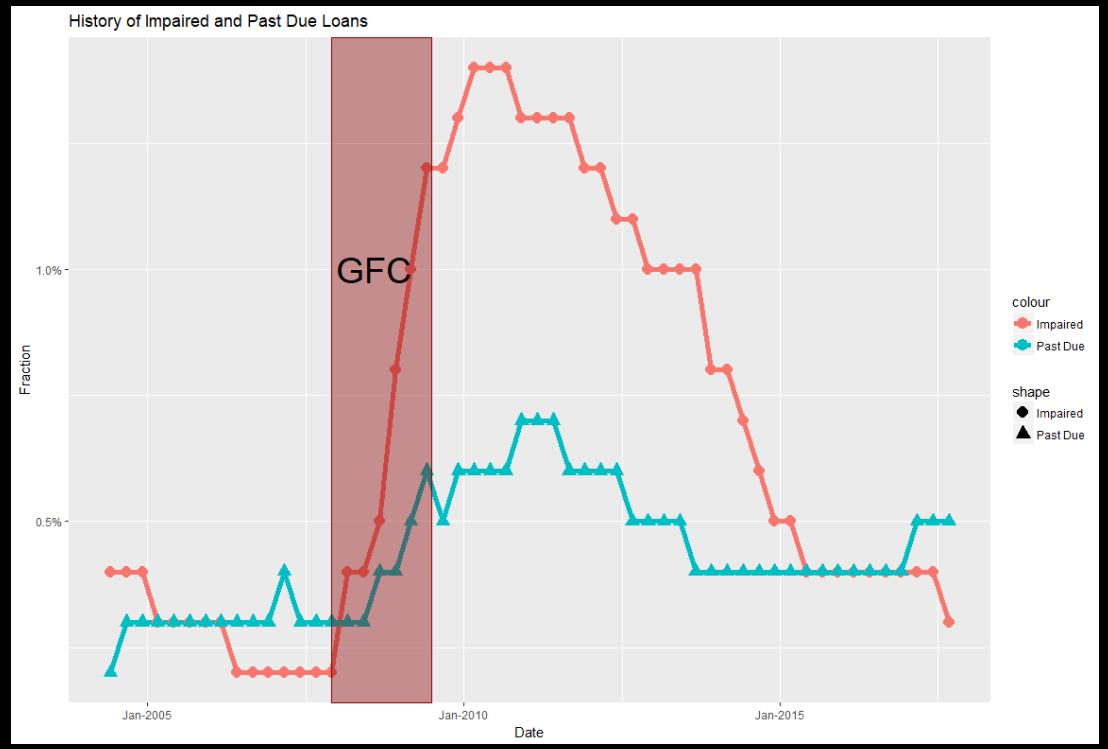
Data Visualisation: Target Variables

- Visual representation of data
  - Trends, periods, outliers
- How you present matters
  - Graph types
  - Graph theme
- Visualisations demonstrate your Tribe



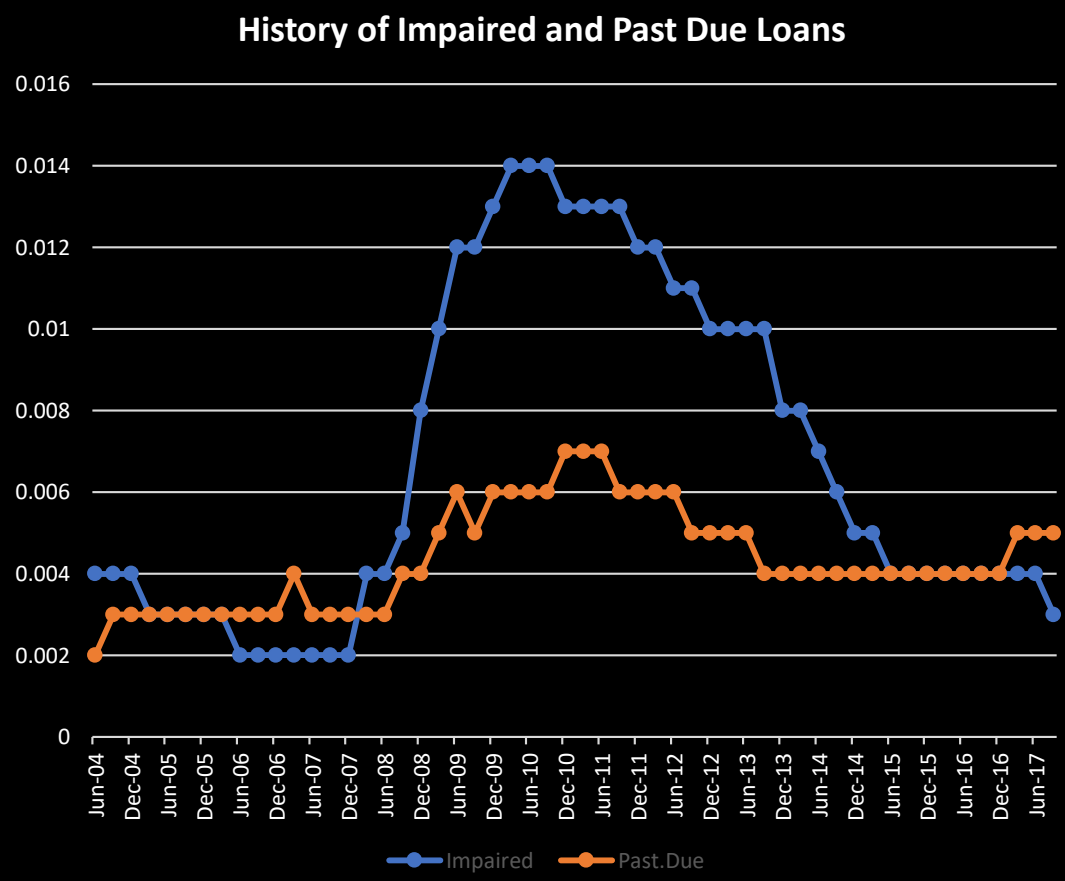
Data Visualisation: Target Variables

- Visual representation of data
  - Trends, periods, outliers
- How you present matters
  - Graph types
  - Graph theme
- Visualisations demonstrate your Tribe



Data Visualisation: Target Variables

- Visual representation of data
  - Trends, periods, outliers
- How you present matters
  - Graph types
  - Graph theme
- Visualisations demonstrate your Tribe



Macro-Economic Data: ABS

- Australian Bureau of Statistics has a “Modeller’s Database” of 119 variables
  - That’s more variables than we have historical data from APRA

Macro-E

- Australian E Database”

Australian Bureau of Statistics

Time Series Workbook

1364.0.15.003 Modellers' Database
Tables 01 to 17

Related Information: Summary Publication Inquiries

Data Item Description	Series Type	Series ID	Series Start	Series End	No. Obs.	Unit	Data Type	Freq.	Collecti Month
Rent and other dwelling services: Current prices ;	Seasonally	A2454446F	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Final Consumption Expenditure: Current prices ;	Seasonally	A2454447J	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Rent and other dwelling services: Chain volume measures ;	Seasonally	A2454448K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Final Consumption Expenditure: Chain volume measures ;	Seasonally	A2454449L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
General government - National ; Final consumption expenditure: Current prices ;	Seasonally	A2454450W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
General government - State and local ; Final consumption expenditure: Current prices ;	Seasonally	A2454451X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Statistical Discrepancy (E) ;	Seasonally	A2454452A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Statistical Discrepancy (I) ;	Seasonally	A2454453C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Commonwealth Government Gross Fixed Capital Formation ;	Seasonally	A2454454F	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
State and Local Government Gross Fixed Capital Formation ;	Seasonally	A2454455J	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
General government - National ; Final consumption expenditure (Chain Volume Measure) ;	Seasonally	A2454456K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
General government - State and local ; Final consumption expenditure (Chain Volume Measure) ;	Seasonally	A2454457L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Statistical Discrepancy (E) (Chain Volume Measure) ;	Seasonally	A2454458R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Commonwealth Government Gross Fixed Capital Formation (Chain Volume Measure) ;	Seasonally	A2454459T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
State and Local Government Gross Fixed Capital Formation (Chain Volume Measure) ;	Seasonally	A2454460A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Dwellings – Total: Current prices ;	Seasonally	A2454461C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Intellectual property products: Current prices ;	Seasonally	A2454462F	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Cultivated biological resources: Current prices ;	Seasonally	A2454463J	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Machinery and equipment - Total: Current prices ;	Seasonally	A2454464K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Dwellings - Total (Chain Volume Measure) ;	Seasonally	A2454465L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Intellectual property products (Chain Volume Measure) ;	Seasonally	A2454466R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Cultivated biological resources (Chain Volume Measure)	Seasonally	A2454467T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Non-dwelling construction - Total (Chain Volume Measur	Seasonally	A2454468V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Private ; Gross fixed capital formation - Machinery and equipment - Total (Chain Volume Measur	Seasonally	A2454469W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Deductions from Gross Rent ;	Seasonally	A2454470F	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Consumption of fixed capital - Non-Financial Corporations and Financial Corporations ;	Original	A2454471J	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Consumption of fixed capital - Dwellings Owned by Persons ;	Original	A2454472K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Consumption of fixed capital - Private Financial Enterprises ;	Original	A2454473L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Consumption of fixed capital - Farm Unincorporated Trading Enterprises ;	Original	A2454474R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Consumption of fixed capital - Non-farm Unincorporated Trading Enterprises ;	Original	A2454475T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Uses of income - Property income payable - Interest on dwellings ;	Seasonally	A2454476V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Uses of income - Property income payable - Total interest ;	Seasonally	A2454477W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Uses of income - Property income payable - Property income payable by unincorporated enterpri	Seasonally	A2454478X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Uses of income - Property income payable - Consumer debt interest ;	Seasonally	A2454480K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Gross agricultural value added at basic prices ;	Seasonally	A2454481L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Gross agricultural value added at producers' prices ;	Seasonally	A2454482R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Agriculture - Taxes less subsidies on products ;	Seasonally	A2454483T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Gross Non-Farm Product at Factor Cost ;	Seasonally	A2454484V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Non-farm ; Gross domestic product ; Current prices ;	Seasonally	A2454485W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Gross domestic product ; Current prices ;	Seasonally	A2454486X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Industry Gross Value Added (Chain Volume Measure) - Agriculture, forestry and fishing - Agricu	Seasonally	A2454487A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Non-farm ; Gross domestic product (Chain Volume Measure) ;	Seasonally	A2454488C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Gross domestic product (Chain Volume Measure) ;	Seasonally	A2454489F	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
End-year net capital stock Non-Financial Corporations and Financial Corporations ; Current prices	Seasonally	A2454491T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Inventories - Private Non-Farm ; Current prices ;	Seasonally	A2454492V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
End-year net capital stock Non-Financial Corporations and Financial Corporations (Chain Volume	Seasonally	A2454493W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Motor Vehicles (Chain Volume Measure) ;	Seasonally	A2454494X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Other Building and Structures : Total (Chain Volume Measure) ;	Seasonally	A2454495A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Household Durables (Chain Volume Measure) ;	Seasonally	A2454496C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
End-year net capital stock - Machinery and Equipment : Total (Chain Volume Measure) ;	Seasonally	A2454497F	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Inventories - Private Non-Farm (Chain Volume Measure) ;	Seasonally	A2454498J	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Changes in inventories - Public authorities and farm ;	Seasonally	A2454499K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Changes in inventories - Private Non-Farm ; Current prices ;	Seasonally	A2454500J	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Stock Valuation Adjustment - Total ;	Seasonally	A2454501K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Changes in inventories - Public authorities and farm (Chain Volume Measure) ;	Seasonally	A2454503R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Changes in inventories - Private Non-Farm (Chain Volume Measure) ;	Seasonally	A2454504T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Imports of goods and services: Current prices ;	Seasonally	A2454505V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Imports : Civil aircraft (Original) ;	Original	A2454506W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Imports : Petroleum (Chain Volume Measure) ;	Seasonally	A2454507X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Imports : Services (Chain Volume Measure) ;	Seasonally	A2454508A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Imports of goods and services (Chain Volume Measure) ;	Seasonally	A2454509C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3
Exports of goods and services: Current prices ;	Seasonally	A2454510L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter	3

Ma

- Australian E Database”

National Level Economy (GDP)

Unemployment Rate

Wage Growth

Time Series Workbook

0.15.003 Modellers' Database

	AO	BR	BV	DO
	Gross domestic product ; Current prices ;	Civilian Labour Force ;	Unemployment ;	Average non-farm compensation per employee per week ($) ;
Unit	$ Millions	000	000	$
Series Type	Seasonally Adjusted	Seasonally Adjusted	Seasonally Adjusted	Seasonally Adjusted
Data Type	DERIVED	DERIVED	DERIVED	DERIVED
Frequency	Quarter	Quarter	Quarter	Quarter
Collection Month	3	3	3	3
Series Start	Sep-1959	Sep-1959	Sep-1959	Sep-1959
Series End	Sep-2017	Sep-2017	Sep-2017	Sep-2017
No. Obs	233	233	233	233
Series ID	A2454486X	A2454517C	A2454521V	A2454570R
Sep-2003	208504	10028.1	578.4	949.0
Dec-2003	213523	10043.6	562.8	961.5
Mar-2004	217572	10078.7	563.0	974.5
Jun-2004	220640	10108.3	533.1	981.8
Sep-2004	223926	10140.1	555.2	1000.2
Dec-2004	227949	10254.5	524.2	1006.4
Mar-2005	232279	10346.8	520.6	1016.2
Jun-2005	237113	10416.1	524.9	1016.3
Sep-2005	243156	10506.4	510.8	1034.1
Dec-2005	248073	10511.7	513.5	1043.2
Mar-2006	250727	10579.3	534.2	1058.2
Jun-2006	254308	10626.3	503.9	1061.6
Sep-2006	262090	10732.7	501.4	1070.2
Dec-2006	268736	10760.2	480.9	1101.5
Mar-2007	275222	10859.0	497.8	1117.8
Jun-2007	279649	10916.2	460.2	1136.9
Sep-2007	284196	11006.6	469.0	1147.4

Stock Valuation Adjustment - Total ;	Seasonally	A2454501K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Changes in inventories - Public authorities and farm (Chain Volume Measure) ;	Seasonally	A2454503R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Changes in inventories - Private Non-Farm (Chain Volume Measure) ;	Seasonally	A2454504T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports of goods and services: Current prices ;	Seasonally	A2454505V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports : Civil aircraft (Original) ;	Original	A2454506W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports : Petroleum (Chain Volume Measure) ;	Seasonally	A2454507X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports : Services (Chain Volume Measure) ;	Seasonally	A2454508A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports of goods and services (Chain Volume Measure) ;	Seasonally	A2454509C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Exports of goods and services: Current prices ;	Seasonally	A2454510L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3

Ma

• A

National Level Economy (GDP)

Time Series Workbook

0.15.003 Modellers' Database

	AO	BR	BV	DO
		Unemployment		

th

Thanks to the ABS for making the data freely available. I acknowledge their copyright to the data.

I have no affiliation with the ABS.

Although I'm using their data, that should not be construed as their endorsement of my work.

Stock Valuation Adjustment - Total ;	Seasonally	A2454501K	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Changes in inventories - Public authorities and farm (Chain Volume Measure) ;	Seasonally	A2454503R	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Changes in inventories - Private Non-Farm (Chain Volume Measure) ;	Seasonally	A2454504T	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports of goods and services: Current prices ;	Seasonally	A2454505V	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports : Civil aircraft (Original) ;	Original	A2454506W	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports : Petroleum (Chain Volume Measure) ;	Seasonally	A2454507X	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports : Services (Chain Volume Measure) ;	Seasonally	A2454508A	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Imports of goods and services (Chain Volume Measure) ;	Seasonally	A2454509C	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3
Exports of goods and services: Current prices ;	Seasonally	A2454510L	Sep-1959	Sep-2017	233	$ Millions	DERIVED	Quarter 3

What you need to know as an Analytics Professional

- Learn about your business area
- Make a checklist of requirements for your solution
- Data is never perfect
  - Where did it come from?
  - Is it documented? Or is there someone you can ask about it?
  - Where is your threshold for “good enough data”?
  - Do you have what you need to achieve project goals?
  - Does the client understand the limitations of the data and what your algorithm cannot reasonably be expected to do?

    Are they limited in capacity or capability?

Modelling procedure

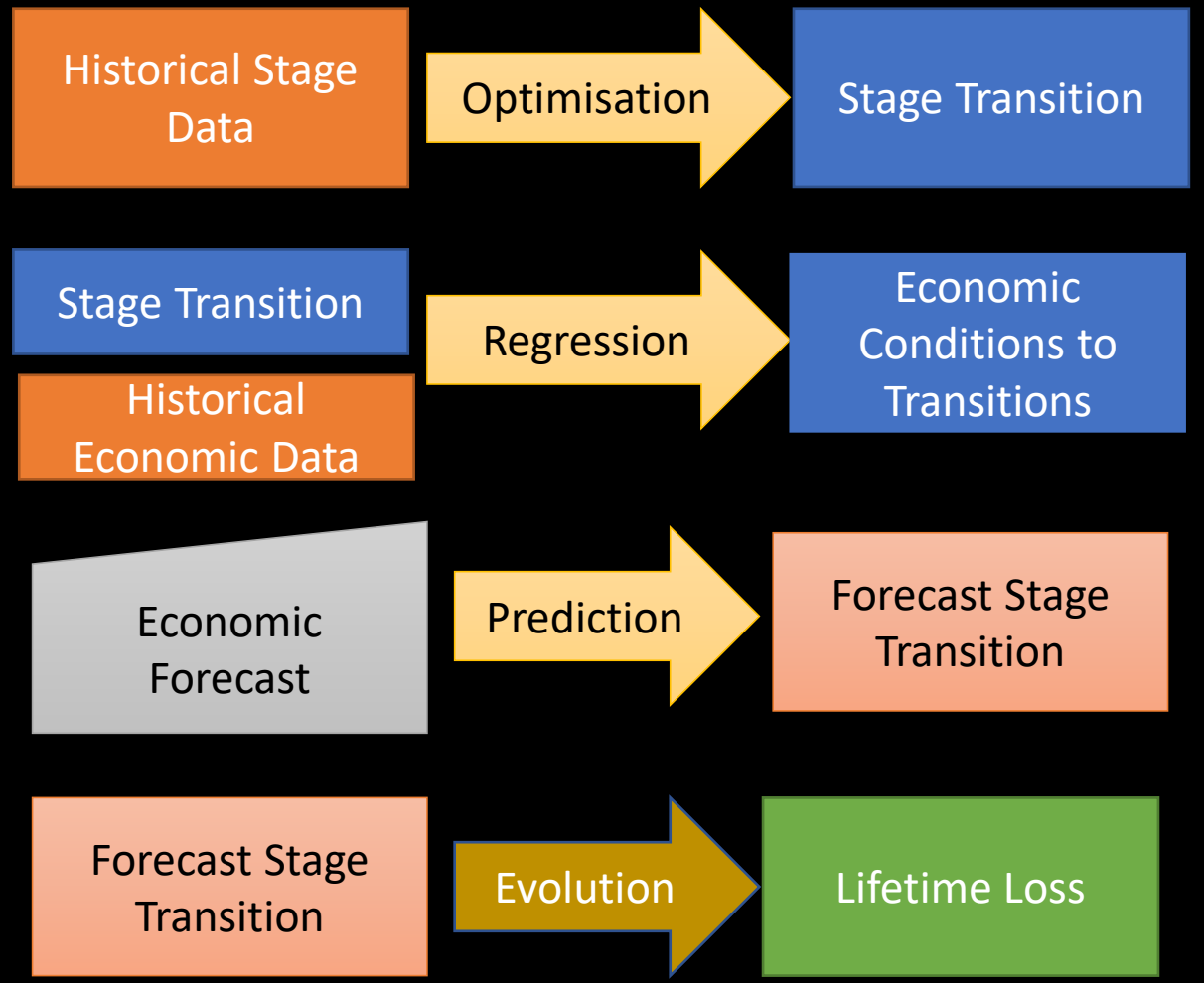
Remember – high level!

If you're an analyst and you get annoyed, imagine how the accountants would feel when I went through all of IFRS 9 in a few slides!

If you're an accountant feeling annoyed, imagine how the Credit Risk Analysts would feel when I went through Credit Risk in 1 slide!

Modelling Procedure: End-to-End Plan

- Need to forecast economic conditions
  - Arbitrary horizon
  - Requires human input – can't rely solely on historical data!
- Migration between stages
  - Contingent upon forecast economic conditions



Modelling Procedure: Stage Transition

- Have historical data of fraction of loans in each Stage
- Estimate a transition matrix based on observed distribution
- For simplicity:
  - Everything entering Stage 3 produces a loss equal to the LGD
  - Migration between Stages i and j given by p_{ij}
- For Evolution
  $s_{t+1} = Ts_t$

$$\underline{T} = \begin{bmatrix} p_{11} & p_{21} \\ p_{12} & p_{22} \\ p_{13} & p_{23} \end{bmatrix}$$

$$\hat{s}_{t+1} = Ts_t$$

For Stages 1 & 2: $\arg\min_{\underline{T}} \| s_{t+1} - \hat{s}_{t+1} \|_2$

Subject to: $0 < p_{ij} < 1$

$$p_{11} + p_{12} + p_{13} = 1$$
$$p_{21} + p_{22} + p_{23} = 1$$

Modelling Procedure: Regression

- Regression theory:

$$y = f(x;\beta) + \epsilon$$

Find suitable f.

- Methods:
  - Pick a functional form, optimize parameters

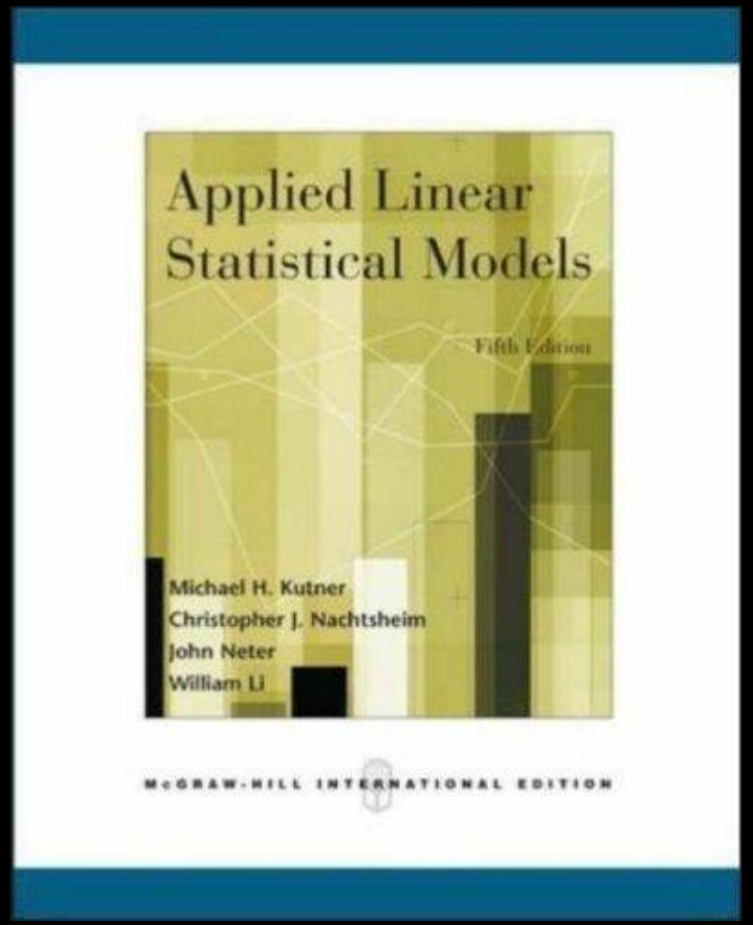
$$y = \underline{X}\beta + \epsilon$$

$$y = \frac{\beta_0 \exp(\beta_1 x)}{1 + \exp(\beta_1 x)} + \epsilon$$

SVM, Neural Networks, LOESS, …

- I used linear regression

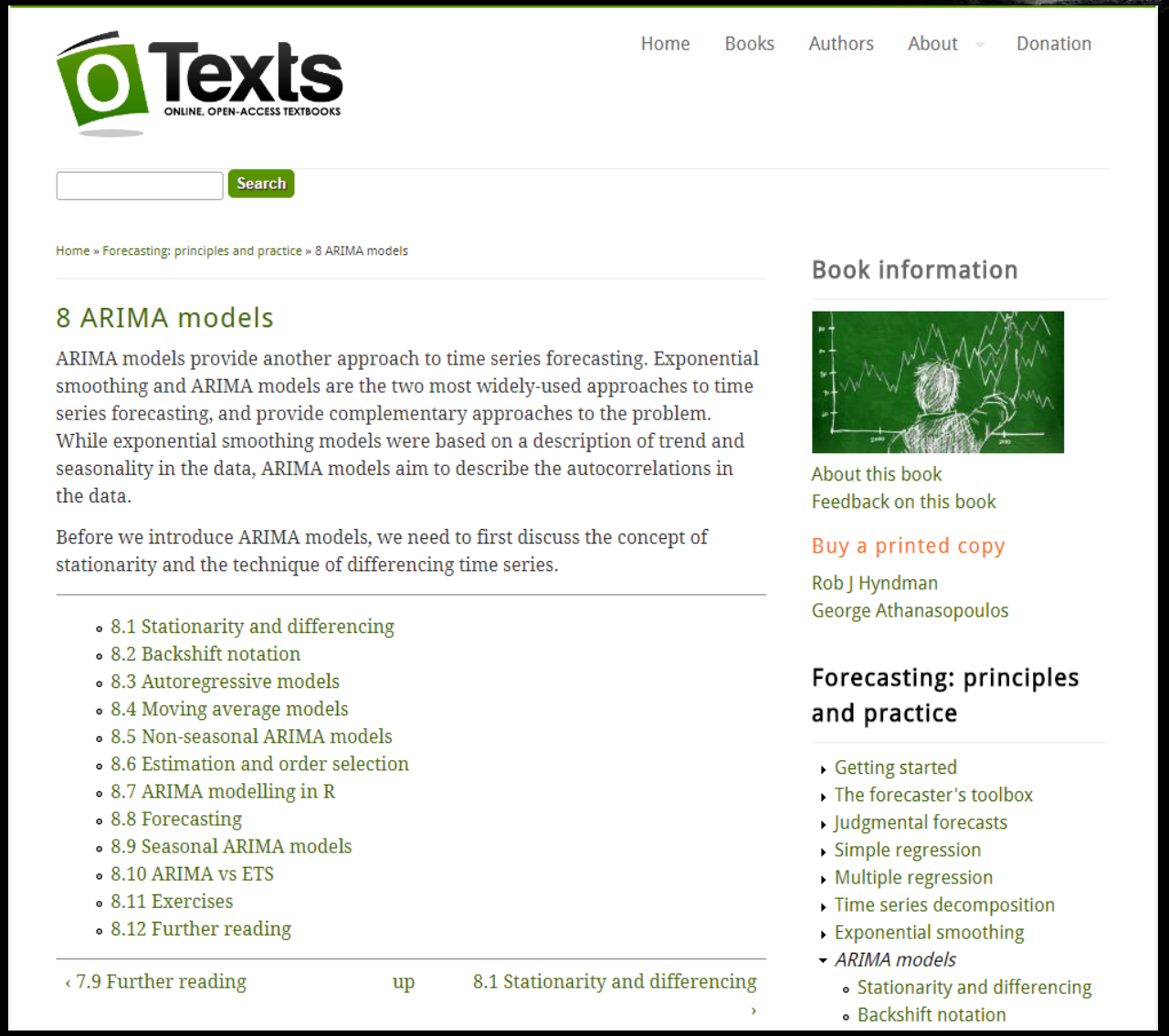
$$p_{ij}(t) \approx \beta_0 + \beta_1 u(t) + \beta_2 \Delta G(t) + \beta_3 \Delta w(t)$$



Kutner, M, et al. Applied Linear Statistical Models. McGraw Hill Education. 5th Edition. 2005.

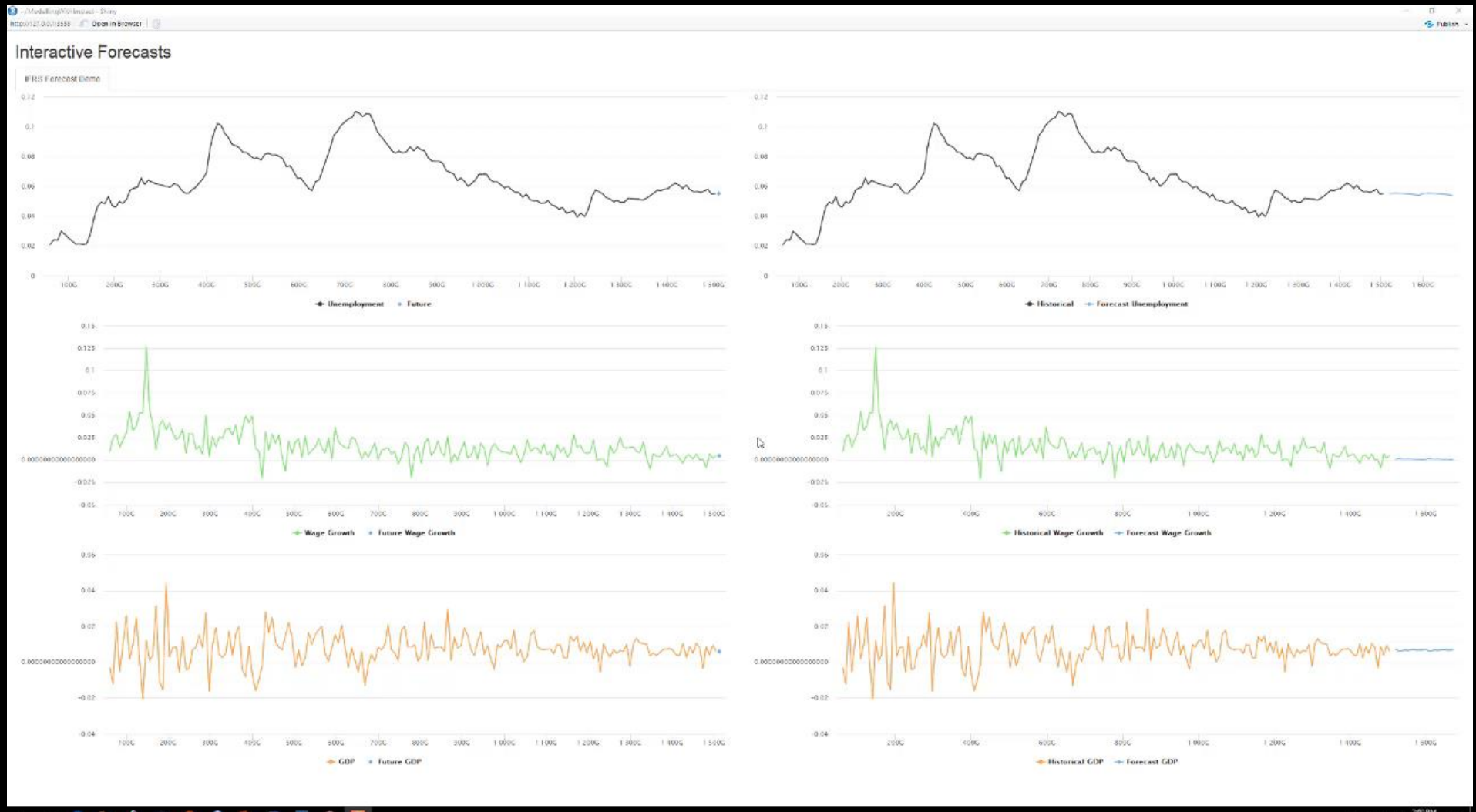
Modelling Procedure: Economic Forecasts

- Forecast methods
  - ARIMA models: Auto-Regressive Integrated Moving Average
  - Vector Auto-Regressive (VAR)
- Diagnostics for “best” model fits
  - Variety of cost functions: Different cost functions imply different models are “best”!
- Can’t use historical data alone, due to IFRS 9 requirements



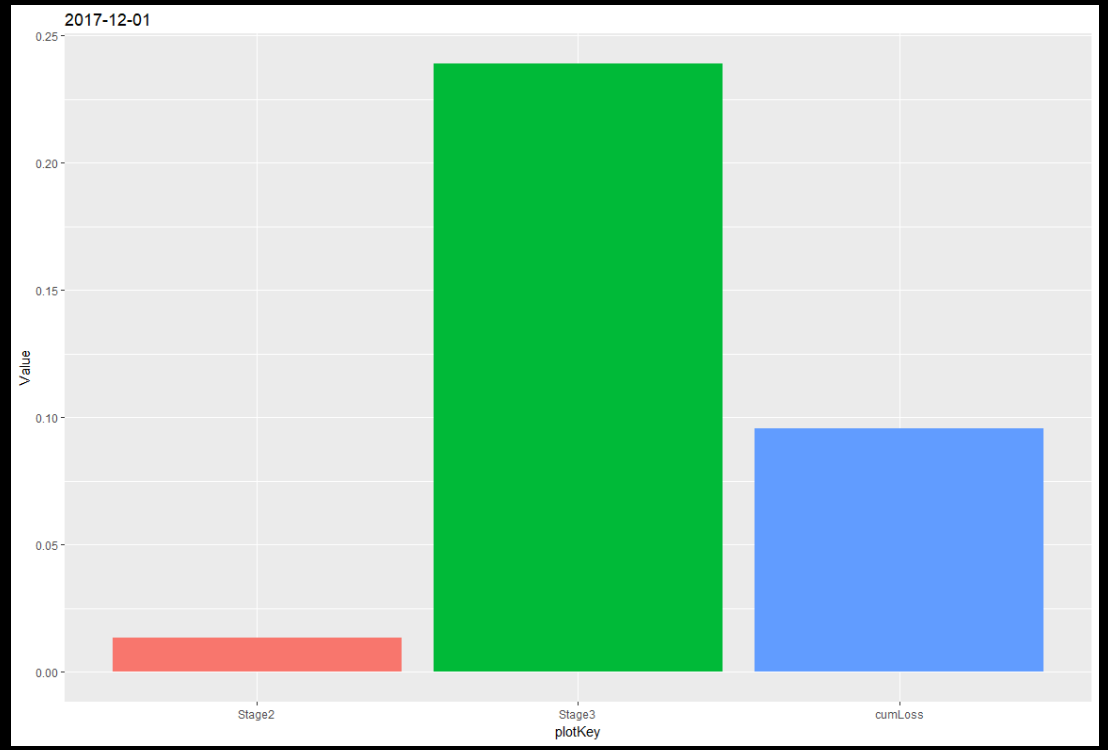
https://www.otexts.org/fpp/8

Modelling Procedure: Economic Forecasts



Modelling Procedure: Evolution

- Only concerned with the part of the portfolio in Stage 2
  - Impulse response: Start with the whole in Stage 2, see how it evolves.
  - Transition matrices calculated based on regression and forecast information
- From Stage 3, 40% (i.e. LGD) is added to cumulative losses
- Results in estimate for lifetime loss.



Modelling Procedure: Evolution

- Only concerned with the part of the portfolio in Stage 2
  - Impulse response: Start with the whole in Stage 2, see how it evolves.
  - Transition matrices calculated based on regression and forecast information
- From Stage 3, 40% (i.e. LGD) is added to cumulative losses
- Results in estimate for lifetime loss.

What you need to know as an Analytics Professional

- Learn about your business area
- Make a checklist of requirements for your solution
- Data is never perfect
- Variety of tools/methods
  - Choice: Specialist or Generalist?
  - Choice: Focus on Algorithms or Problems?
  - Algorithms vs Problem
    - Kalman filters, Wavelets, SVM, k-means, ARIMA, Fuzzy Logic, Graph Theory
    - Tracking, Feature Extraction, Classification, Clustering, Forecasting, Fusion, Assignment
- Stakeholder engagement/ownership

Modelling Review

- Everything on the requirements done
  - Cumulative loss by month – need discount factor, but easily calculated
  - Forecast based on Expert Input + VAR models
  - Transition based on forecast macro-economics
- Review: Present to stakeholders

Modelling Review

- Host of technical assumptions, questions, problems:

  What training/test data methodology did you use?

Modelling Review

- Host of technical assumptions, questions, problems:

  ~~*What training/test data methodology did you use?*~~

  What tests for appropriateness did you use for your VAR?

Modelling Review

- Host of technical assumptions, questions, problems:

  ~~*What training/test data methodology did you use?*~~

  ~~*What tests for appropriateness did you use for your VAR?*~~

  What other regression options did you investigate?

Modelling Review

- Host of technical assumptions, questions, problems:

  ~~*What training/test data methodology did you use?*~~

  ~~*What tests for appropriateness did you use for your VAR?*~~

  ~~*What other regression options did you investigate?*~~

Modelling Review

- Host of technical assumptions, questions, problems:

~~*What training/test data methodology did you use?*~~

What's the Impact?

~~*What other regression options did you investigate?*~~

Impacts: Case-Study Ernst & Young Survey

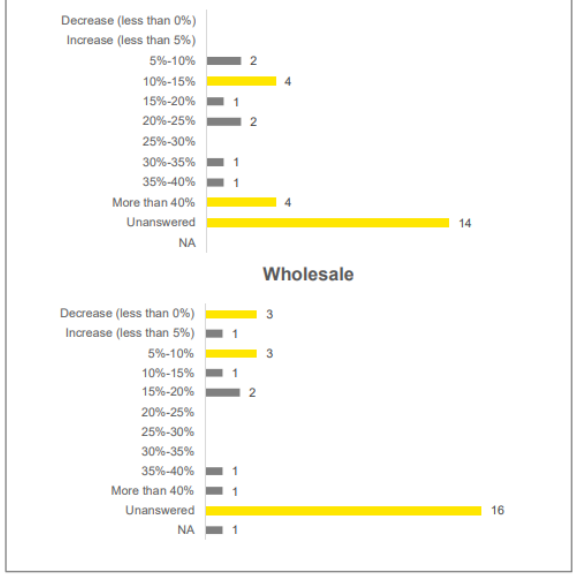
http://www.ey.com/Publication/vwLUAssets/ey-ifrs-9-impairment-banking-survey-new/$FILE/ey-ifrs-9-impairment-banking-survey.pdf

Impacts: Case-Study Ernst & Young Survey

1. Impact assessment – impairment provisions

Expected percentage increase in total impairment provisions on transition to IFRS 9 (continued)

Data



Commentary

Credit card exposures driving increase in retail provisions

- Retail portfolios will be most impacted by the adoption of IFRS 9, in particular, because of exposures classified as stage 2, and resulting lifetime expected credit loss (ECL) requirements.
- The highest impact has been reported on credit card portfolios, with four banks expecting more than 40% increase in provisions. This is largely due to the requirement to calculate ECL for both the drawn and undrawn exposures.
- Some banks reported a significant impact on unsecured products, especially with the introduction of a 12-month expected loss for stage 1 exposures.
- There is more diversity on the impact of mortgages: four banks expect an increase of 5%-10%; three an increase of more than 40%; one a decrease.

Wholesale impact expected to be less significant

- The expected impact on wholesale portfolios is generally lower than the impact on retail portfolios, with the exception of "central governments and central banks" and "financial institutions", where it appears more significant as they currently attract no, or only small, provisions. However, the absolute impact is expected to be small due to the high quality of these assets.
- The introduction of 12-month ECL for financial instruments that are considered to have low credit risk contributes to the increase in wholesale provisions.
- Some banks noted little change, or even a decrease, in ECL for corporates, primarily resulting from relatively long emergence period used under IAS 39, but also because of very high credit quality or significant collateral. This is more evident for countries where larger collective provisions were being booked on watch list exposures under IAS 39.
- Some corporate assets were also reclassified to fair value through profit and loss, which are not subject to credit impairment.

- *"There is more diversity on the impact of mortgages: four banks expect an increase of 5%-10%; three an increase of more than 40%; one a decrease."*

http://www.ey.com/Publication/vwLUAssets/ey-ifrs-9-impairment-banking-survey-new/$FILE/ey-ifrs-9-impairment-banking-survey.pdf

Impacts: Case-Study
National Australia Bank (NAB)

https://www.nab.com.au/content/dam/nabrwd/legacy/about-us/shareholder-centre/financial-results/documents/half-year-results-2015.pdf

Impacts: Case-Study National Australia Bank (NAB)

National Australia Bank Limited ABN 12 004 044 937

This was driven by:
- Lower specific charges for business lending and the unsecured retail portfolio in Australian Banking
- Recoveries in UK Banking reflecting an improvement in the UK economy
- Further reductions to NAB UK CRE impaired assets.

The March 2015 half year collective provision B&DD charge was $49 million. This includes an overlay for Australian agriculture and resource sectors as market conditions continued to tighten in these segments.

Provisions for Bad and Doubtful Debts

Total provisions for B&DDs increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9. This was partially offset by a decrease in NAB UK CRE provisions (£262 million) resulting from loan sales in the half year.

Specific provisions decreased by $547 million to $907 million for the March 2015 half year, largely driven by the disposal of the NAB UK CRE loans (£177 million) and continued improvement in the performance of the Australian Banking impaired portfolio.

The Group coverage of specific provisions to gross impaired assets increased marginally from 35.3% at September 2014 to 35.5% at March 2015.

Total collective provisions have increased since September 2014 to $3,444 million at March 2015. Excluding the impact of AASB 9 transitional adjustments and foreign exchange, there was an underlying reduction of $48 million. This was mainly due to the sale of NAB UK CRE loans which resulted in a collective provision release, partly offset by an overlay for the agriculture and resource sectors in Australia and an increase in the potential credit exposure on the Group's derivatives portfolio driven by mark-to-market movements.

The collective provision to credit risk weighted assets ratio has increased by 18 basis points from 0.83% at September 2014 to 1.01% at March 2015. Excluding the impact of AASB 9 transitional adjustments, the collective provision coverage was seven basis points lower largely due to the sale of NAB UK CRE loans in the half.

90+ Days Past Due and Gross Impaired Assets

	As at		
	Mar 15	**Sep 14**	**Mar 14**
90+ days past due loans ($m)	**2,292**	2,342	2,526
Gross impaired assets ($m)	**2,558**	4,122	5,614
90+ days past due and gross impaired assets ($m)	**4,850**	6,464	8,140

	As at		
	Mar 15	**Sep 14**	**Mar 14**
90+ days past due loans to gross loans and acceptances	**0.40%**	0.43%	0.47%
Gross impaired assets to gross loans and acceptances	**0.45%**	0.76%	1.05%
90+ days past due and gross impaired assets to gross loans and acceptances	**0.85%**	1.19%	1.52%

Non-Impaired Assets 90+ Days Past Due

The Group ratio of 90+ days past due loans to gross loans and acceptances (90+ DPD ratio) declined by three basis points to 0.40% during the March 2015 half year, mainly due to the sale of NAB UK CRE loans in the half. In addition, improvements were observed in Group's business lending and retail lending 90+ DPD ratios.

Gross Impaired Assets

The Group ratio of gross impaired assets to gross loans and acceptances (impaired asset ratio) decreased by 31 basis points to 0.45% during the March 2015 half year. The improvement was mainly driven by the business lending portfolio, reflecting the sale of NAB UK CRE impaired assets (£430 million) and a general decrease in impairment activity for Australian Banking and UK Banking.

Net Write-Offs

The Group's net write-offs to gross loans and acceptances annualised ratio decreased by nine basis points to 0.22% during the March 2015 half year. The decline was experienced across all major operating regions, excluding UK Banking.

The 12 month rolling net write-off rate for the Group's retail portfolio decreased two basis points to 0.12% over the six months to March 2015 and declined by one basis point to 0.03% for the Group's housing portfolio.

https://www.nab.com.au/content/dam/nabrwd/legacy/about-us/shareholder-centre/financial-results/documents/half-year-results-2015.pdf

Impacts: Case-Study National Australia Bank (NAB)

National Australia Bank Limited ABN 12 004 044 937

This was driven by:
- Lower specific charges for business lending and the unsecured retail portfolio in Australian Banking
- Recoveries in UK Banking reflecting an improvement in the UK economy
- Further reductions to NAB UK CRE impaired assets.

The March 2015 half year collective provision B&DD charge was $49 million. This includes an overlay for Australian agriculture and resource sectors as market conditions continued to tighten in these segments.

Provisions for Bad and Doubtful Debts

Total provisions for B&DDs increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9. This was partially offset by a decrease in NAB UK CRE provisions (£262 million) resulting from loan sales in the half year.

Specific provisions decreased by $547 million to $907 million for the March 2015 hal
the disposal of the NAB UK C
and continued improvement i
Australian Banking impaired p

The Group coverage of specif
impaired assets increased ma
September 2014 to 35.5% at

Total collective provisions hav
September 2014 to $3,444 mi
Excluding the impact of AASB
and foreign exchange, there w
of $48 million. This was main
UK CRE loans which resulted
release, partly offset by an ov
and resource sectors in Austra
the potential credit exposure
portfolio driven by mark-to-ma

The collective provision to cre
ratio has increased by 18 bas
September 2014 to 1.01% at
impact of AASB 9 transitional
provision coverage was sever
due to the sale of NAB UK CR

90+ Days Past Due and Assets

90+ days past due loans ($m)			
Gross impaired assets ($m)			
90+ days past due and gross impaired assets ($m)			
90+ days past due loans to gross loans and acceptances	0.40%	0.83%	0.91%
Gross impaired assets to gross loans and acceptances	0.45%	0.76%	1.05%
90+ days past due and gross impaired assets to gross loans and acceptances	0.85%	1.19%	1.52%

Non-Impaired Assets 90+ Days Past Due

The Group ratio of 90+ days past due loans to gross loans and acceptances (90+ DPD ratio) declined by three basis points to 0.40% during the March 2015 half year, mainly due to the sale of NAB UK CRE loans in the half. In addition, improvements were observed in Group's business lending and retail lending 90+ DPD ratios.

Gross Impaired Assets

The Group ratio of gross impaired assets to gross loans and acceptances (impaired asset ratio) decreased by 31 basis points to 0.45% during the March 2015 half year. The improvement was mainly driven by the business lending portfolio, reflecting the sale of NAB UK CRE impaired assets (£430 million) and a general decrease in impairment activity for Australian Banking and UK Banking.

Net Write-Offs

"Total provisions for [Bad and Doubtful Debts] increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9."

https://www.nab.com.au/content/dam/nabrwd/legacy/about-us/shareholder-centre/financial-results/documents/half-year-results-2015.pdf

Impacts: Case-Study National Australia Bank (NAB)

National Australia Bank Limited ABN 12 004 044 937

Review of Operating Environment, Group Operations and Results

Half Year Results 2015

This was driven by:
- Lower specific charges for business lending and the unsecured retail portfolio in Australian Banking
- Recoveries in UK Banking reflecting an improvement in the UK economy
- Further reductions to NAB UK CRE impaired assets.

The March 2015 half year collective provision B&DD charge was $49 million. This includes an overlay for Australian agriculture and resource sectors as market conditions continued to tighten in these segments.

Provisions for Bad and Doubtful Debts

Total provisions for B&DDs increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9. This was partially offset by a decrease in NAB UK CRE provisions (£262 million) resulting from loan sales in the half year.

Specific provisions decreased by $547 million to $907 million for the March 2015 hal... the disposal of the NAB UK C... and continued improvement i... Australian Banking impaired p...

The Group coverage of specif... impaired assets increased ma... September 2014 to 35.5% at ...

Total collective provisions hav... September 2014 to $3,444 mi... Excluding the impact of AASB... and foreign exchange, there w... of $48 million. This was main... UK CRE loans which resulted... release, partly offset by an ov... and resource sectors in Austra... the potential credit exposure o... portfolio driven by mark-to-ma...

The collective provision to cre... ratio has increased by 18 bas... September 2014 to 1.01% at ... impact of AASB 9 transitional ... provision coverage was sever... due to the sale of NAB UK CR...

90+ Days Past Due and ... Assets

90+ days past due loans ($m)			
Gross impaired assets ($m)			
90+ days past due and gross impaired assets ($m)			
90+ days past due loans to gross loans and acceptances			
Gross impaired assets to gross loans and acceptances	**0.45%**	0.76%	1.05%
90+ days past due and gross impaired assets to gross loans and acceptances	**0.85%**	1.19%	1.52%

Non-Impaired Assets 90+ Days Past Due

The Group ratio of 90+ days past due loans to gross loans and acceptances (90+ DPD ratio) declined by three basis points to 0.40% during the March 2015 half year, mainly due to the sale of NAB UK CRE loans in the half. In addition, improvements were observed in Group's business lending and retail lending 90+ DPD ratios.

Gross Impaired Assets

The Group ratio of gross impaired assets to gross loans and acceptances (impaired asset ratio) decreased by 31 basis points to 0.45% during the March 2015 half year. The improvement was mainly driven by the business lending portfolio, reflecting the sale of NAB UK CRE impaired assets (£430 million) and a general decrease in impairment activity for Australian Banking and UK Banking.

Net Write-Offs

32

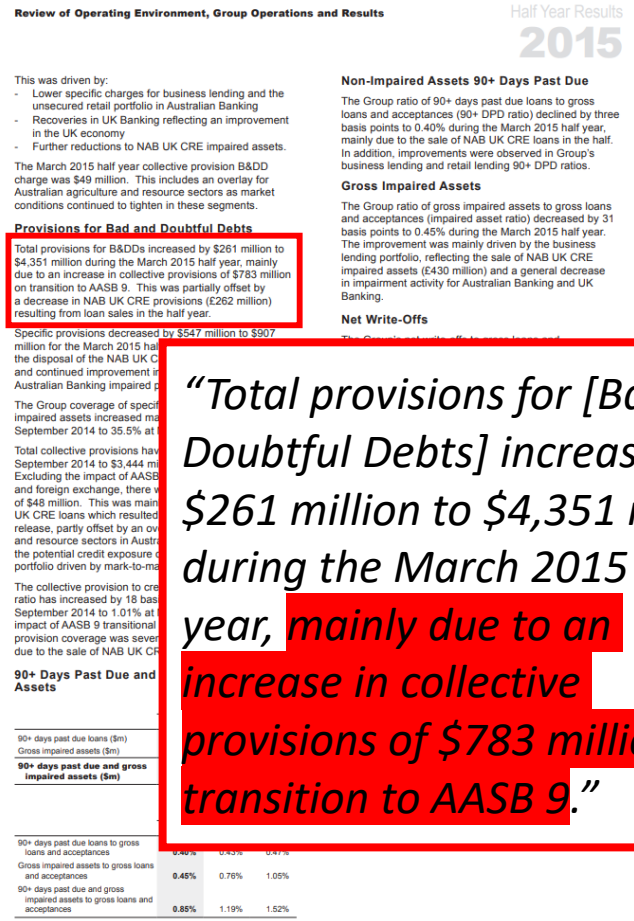
"Total provisions for [Bad and Doubtful Debts] increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9."

NAB IFRS 9 Impact

(As at June, 2015, that was about US$590million)

https://www.nab.com.au/content/dam/nabrwd/legacy/about-us/shareholder-centre/financial-results/documents/half-year-results-2015.pdf

Impacts: Case-Study National Australia Bank (NAB)



Review of Operating Environment, Group Operations and Results

Half Year Results 2015

This was driven by:
- Lower specific charges for business lending and the unsecured retail portfolio in Australian Banking
- Recoveries in UK Banking reflecting an improvement in the UK economy
- Further reductions to NAB UK CRE impaired assets.

The March 2015 half year collective provision B&DD charge was $49 million. This includes an overlay for Australian agriculture and resource sectors as market conditions continued to tighten in these segments.

Provisions for Bad and Doubtful Debts

Total provisions for B&DDs increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9. This was partially offset by a decrease in NAB UK CRE provisions (£262 million) resulting from loan sales in the half year.

Specific provisions decreased by $547 million to $907 million for the March 2015 hal... the disposal of the NAB UK C... and continued improvement i... Australian Banking impaired p...

The Group coverage of specif... impaired assets increased ma... September 2014 to 35.5% at ...

Total collective provisions hav... September 2014 to $3,444 mi... Excluding the impact of AASB... and foreign exchange, there w... of $48 million. This was main... UK CRE loans which resulted... release, partly offset by an ov... and resource sectors in Austra... the potential credit exposure ... portfolio driven by mark-to-ma...

The collective provision to cre... ratio has increased by 18 bas... September 2014 to 1.01% at ... impact of AASB 9 transitional ... provision coverage was sever... due to the sale of NAB UK CR...

90+ Days Past Due and ... Assets

90+ days past due loans ($m)			
Gross impaired assets ($m)			
90+ days past due and gross impaired assets ($m)			
90+ days past due loans to gross loans and acceptances	0.40%	0.43%	0.47%
Gross impaired assets to gross loans and acceptances	0.45%	0.76%	1.05%
90+ days past due and gross impaired assets to gross loans and acceptances	0.85%	1.19%	1.52%

Non-Impaired Assets 90+ Days Past Due

The Group ratio of 90+ days past due loans to gross loans and acceptances (90+ DPD ratio) declined by three basis points to 0.40% during the March 2015 half year, mainly due to the sale of NAB UK CRE loans in the half. In addition, improvements were observed in Group's business lending and retail lending 90+ DPD ratios.

Gross Impaired Assets

The Group ratio of gross impaired assets to gross loans and acceptances (impaired asset ratio) decreased by 31 basis points to 0.45% during the March 2015 half year. The improvement was mainly driven by the business lending portfolio, reflecting the sale of NAB UK CRE impaired assets (£430 million) and a general decrease in impairment activity for Australian Banking and UK Banking.

Net Write-Offs

32

"Total provisions for [Bad and Doubtful Debts] increased by $261 million to $4,351 million during the March 2015 half year, mainly due to an increase in collective provisions of $783 million on transition to AASB 9."

NAB IFRS 9 Impact

https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)
Per the United Nations, 2016

192	Grenada	884
193	Saint Kitts and Nevis	852
194	The Gambia	851
195	Samoa	824
196	Vanuatu	812
197	Turks and Caicos Islands	797
198	Saint Vincent and the Grenadines	729
199	Comoros	648
200	Dominica	533
201	Tonga	435
202	São Tomé and Príncipe	337
203	Federated States of Micronesia	308

(As at June, 2015, that was about US$590million)

https://www.nab.com.au/content/dam/nabrwd/legacy/about-us/shareholder-centre/financial-results/documents/half-year-results-2015.pdf

Conclusion: Modelling with Impact

- ***Modelling with Impact*** doesn't refer to:
  - Jargon
  - Presentation Style
  - Colour schemes
  - Interactive plots
  - Animated GIFs
- If your model goes live tomorrow, what do you expect to happen?

$$\sum_{t=1}^{20} FV(t)\exp(-r_d t)$$

With a 1%/quarter discount rate (~4.1% annual)

Conclusion: Modelling with Impact

- ***Modelling with Impact*** doesn't refer to:
  - Jargon
  - Presentation Style
  - Colour schemes
  - Interactive plots
  - Animated GIFs
- If your model goes live tomorrow, what do you expect to happen?

$$\sum_{t=1}^{20} FV(t)\exp(-r_d t)$$

With a 1%/quarter discount rate (~4.1% annual)

A$2.7Billion

Acknowledgements

- Citizens Data Science Meetup: Microsoft & Sudarshan Roy
- APRA and ABS for making data freely available
- Awkward Taylor Swift Dancing Tumblr

Where you can find me

- YouTube

  https://goo.gl/Mjp6Sc
- GitHub

  https://github.com/SavageDoc/