READI

Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Actuarial Research

Mary Hardy, University of Waterloo

Presented in ASARP Workshop in ITB, 26 – 27 March 2018

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO

READI

Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Part 1
How to do (actuarial) research

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

What is research?

"The systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions."

OED

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Research Papers in the Seminar Package

- *Market-Consistent Valuation and Funding of Cash Balance Pensions* Hardy et al. (2013) NAAJ.
- *A Two-factor Model For Stochastic Mortality With Parameter Uncertainty: Theory And Calibration.* Cairns et al (2006) JRI.
- *Annuitization and asset allocation under exponential utility.* Liang and Young (2018) IME
- *Double Chain Ladder.* Miranda et al (2012) ASTIN Bulletin

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Research Papers in the Seminar Package

- *Lapse tables for lapse risk management in insurance: a competing risk approach.* Millhaud & Dutang (2018) EAJ
- *Efficient Nested Simulation for Conditional Tail Expectation of Variable Annuities.* Dang et al (2018)
- *A Regime-Switching Model of Long-Term Stock Returns.* Hardy (2001) NAAJ
- *Pricing Annuity Guarantees under a Regime Switching Model.* Lin et al, 2009. NAAJ

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Types of research

- Basic Research
- Applied Research
  - Action
  - Problem-Driven
- Descriptive
- Quantitative
- Qualitative

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Basic Research

- Has different meanings in different disciplines
  - Not motivated by a practical problem
  - Exploratory
  - Foundational.

"There is nothing so practical as a good theory"

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

What people say about basic research

- Motivated by knowledge for knowledge's sake
- "Blue skies" research
- For understanding theoretical relationships
- Explanatory and Exploratory
- Lays the foundation for applied science
- Ultimate goal is to provide broader resource for applied research
- So it should not be pointless…

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Applied Research

- Applied Research
  - Addresses specific practical problems
  - Generally more interested in empirical methodologies
  - Real world context
- ‘Problem Driven Research’ or ‘Action Research’ is a special case of applied research

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

What people say about applied research

- Addresses practical problems
- Data-driven
- More descriptive or prescriptive than explanatory
- Often sponsored by industry

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO

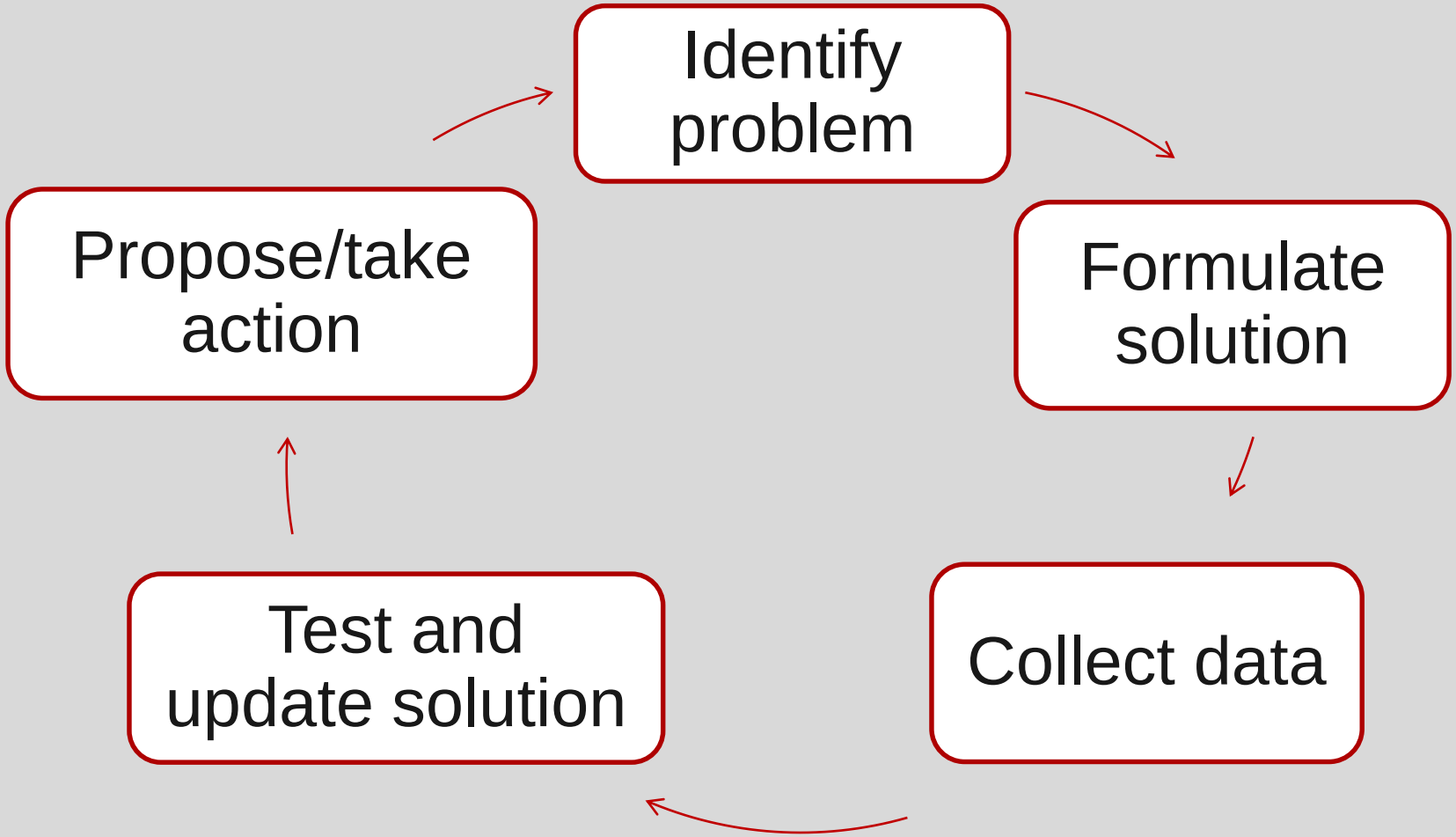
READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Action Research

- Considers an immediate solution to a real problem
- End-user focussed
- Specific setting and applicability
- Based on science, using resources from the foundations of the discipline
- Bridges theory and practice
- Not aimed at increasing general knowledge
  - Aimed at solving a problem.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Action Research Cycle



Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

More research classification

- Quantitative
  - Data driven, empirical, uses probability and statistics theory
  - May be purely descriptive
  - Or extend to investigating causality,
- Qualitative
  - Observational, synthesis, historical

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Qualities of good science research

- Clearly defined purpose
- Coherent project development
- Adequate, relevant data
- Rigorous, scientifically appropriate analysis of data
- Limitations, weaknesses identified, reported and as far as possible quantified.
- Error-free
- Conclusions justified by the analysis and the prior science

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Qualities of good science research

- Published account is coherent, readable, accessible by the targeted readership.
  - Not unnecessarily complicated or puffed up
- Results are reproducible.
- Researcher acts with integrity and honesty throughout.
  - Avoid too much advocacy or over attachment.
- **Defend science !!!**

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Actuarial Science Research

- Actuarial Science is defined by the context of our work
- It is inherently an applied discipline
- We are engineers looking for solutions to problems.
- Most effective actuarial research is applied
  - Research user focus
  - End-user focus

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Examples in actuarial science

- Blue skies research into new ways to design pension plans
- Development of risk measures for economic capital for life insurers
- Development of valuation and risk management methodology for Cash Balance pension plans
- Numerical experiments in life insurance investment management
- Survey of risk attitudes in pre-retirees

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

How to do research - wikihow

1. **Find a good question**
2. Narrow the focus
3. Review existing body of relevant research
4. Form a hypothesis
5. Do the analysis to test your hypothesis
6. Refine your hypothesis (and/or initial question). Go back to step 4.

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

How to do research

If your hypothesis appears to be validated (and relevant)

7. Outline your paper
8. Start writing

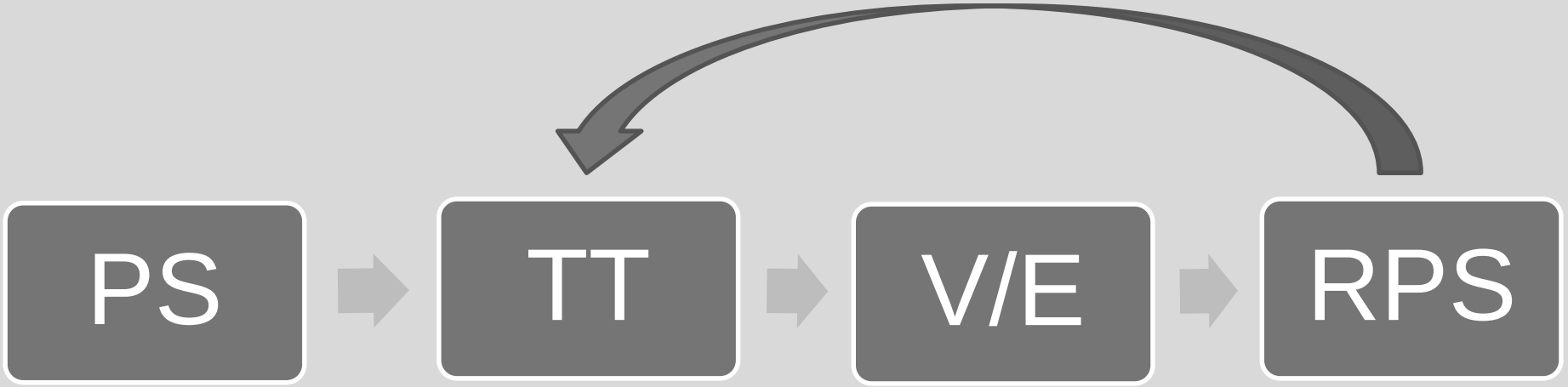
» Skip back and forth between steps as needed

» Be prepared to change your thesis, methodology

» Be prepared to start again with a new question.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

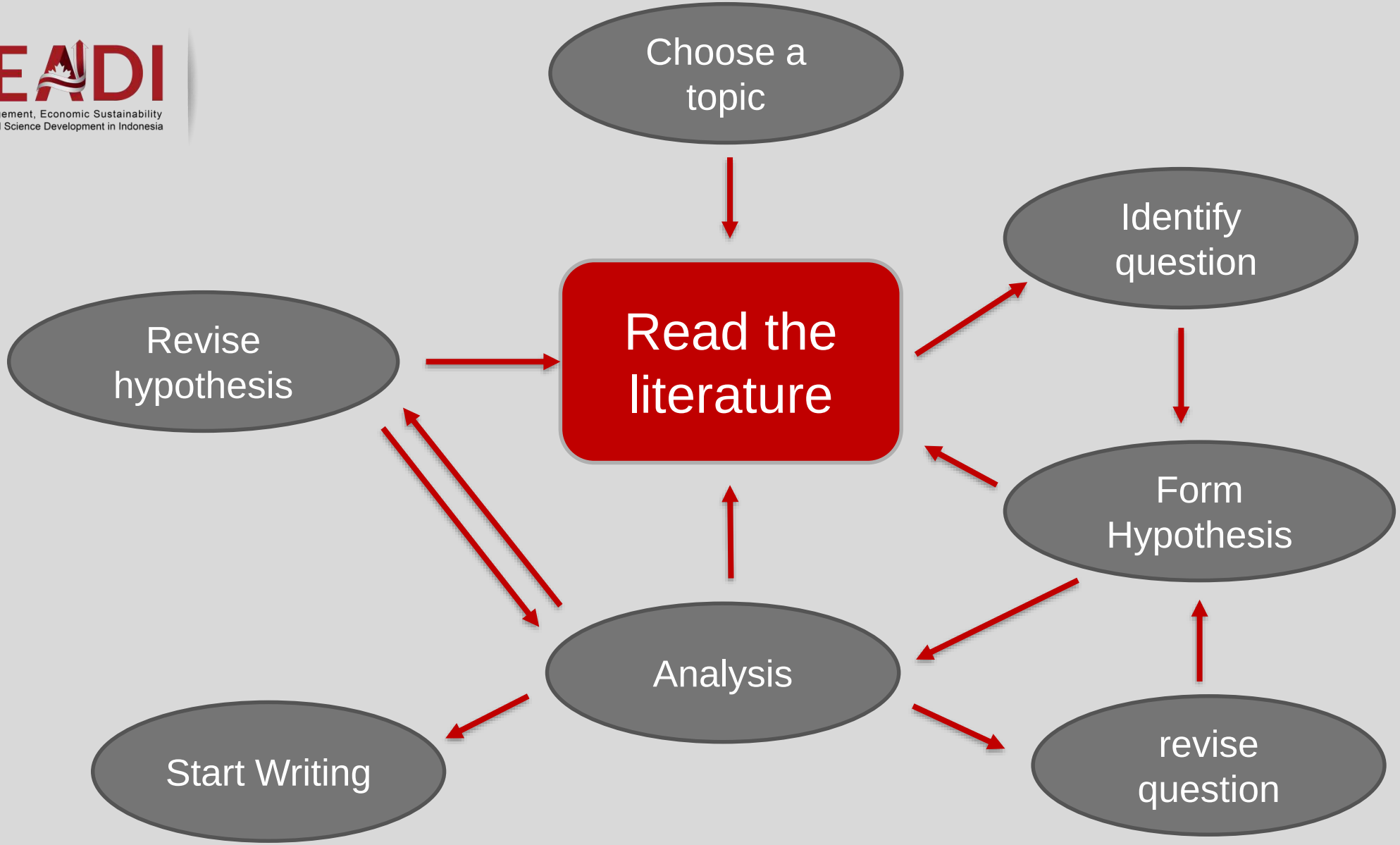
Popper's theory of science research



PS=Problem Statement
TT=Tentative Theory
V/E= Verify / eliminate
RPS= Revised Problem Statement

Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia



Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

1. Find a good question

- Who is interested in this question?
- Who should be interested?
- Will researching this topic help the world?
- Do I have access to the resources I need to address this question?
  - Technical expertise
  - Data
  - Practical / industry knowledge?

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Where to find your question?

- From existing academic literature or seminars
  - Can the work be improved by refining the method or assumptions?
  - Can the method in a paper be applied to a different problem?
- From co-authors
  - Seek partners with complementary skillsets

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Where to find your question?

» From the insurance/ pension industry

- Review content from professional meetings
- Learn about current challenges, topics of interest
- Narrow the general challenge down to a specific group of questions that are suited to academic research.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Where to find your question?

- If you have access to interesting data
  - Let the data tell you what the question is!
  - Are there any surprising features?
  - Is there any value in developing predictive models from the data?

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

What not to do when formulating your question

- Don’t be too vague
  - E.g. “ I want to research takaful insurance”
    - It’s not a question
    - What do you want to research about it?
    - It can be a starting point.

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

What not to do when formulating your question

» Don't be too narrow

- E.g. " *I want to apply Levy Processes to value embedded options*"
- Researcher knows Levy Processes and is looking for applications
- OK if and only if the problem really benefits from the treatment.
- What is Levy Processes are not empirically consistent?

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Task – Identify the questions in the sample papers.

- Does the paper explain its question in the introductory sections?
- Are the questions interesting? Important?
- Who are the papers written for?
- Can you identify how the authors found their question?

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Review existing literature

- Often not done sufficiently by novice researchers
- Use **Google Scholar** or **Harzing's Publish or Perish**
- When you find a relevant paper, check through its references for others.
- Evaluate sources.
  - Is the work peer-reviewed?
  - Is it sufficiently up-to-date?

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Review existing literature

- Keep notes on papers referenced directly or indirectly.
  - And remember to cite them in your work
- Keep going back to the literature as you refine your question.
- Check for relevant work in other disciplines.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Form a hypothesis

- A hypothesis is a statement that can be proved or disproved.
  - It is not a question. It is a proposed answer to a question.
- At the start of a project, the hypothesis may be quite vague.
- Full specification may come later in the process.
- There may be several hypotheses before you find one that works out.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Form a hypothesis

- You have data to analyze?
  - Hypothesis might be "*Model X provides a better predictive fit to data than previously proposed models*"
- Are you exploring a new approach to an existing problem?
  - "*Using this approach will generate new insights into the underlying processes*"

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Do the analysis

- Does it work?
  - Be willing to adapt it or even give it up
- Is it original
  - What if someone gets there before you?
- Note assumptions, weaknesses, limitations
  - Test to destruction
  - Sensitivity analysis
  - Confidence intervals

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Outline your paper

- Your paper should be **coherent**
  - That is, there should be a linear story
  - Introduction, body, conclusion
- Begin writing
  - As you write, refine and develop your analysis

READI

Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Part 2
Actuarial Research Topics

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Property and Casualty Insurance

- Claims reserving methods
- Credibility theory
- Ruin theory …
- Models of claim frequency and severity
- Optimal Reinsurance
- Agricultural insurance

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Life Insurance

- Longevity and mortality models
- Variable Annuity valuation and risk management
- Lapse modelling; policyholder behaviour
- Securitisation of insurance risk

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Pensions

- Public pensions policy
- De-risking longevity risk
- Annuitization decisions
- Asset-liability management – LDI

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Health Insurance

- Application of predictive analytics / statistical learning to health data
- Design, pricing, valuation for long term health insurance
  - Long term care
  - Critical Illness

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Risk Management

- Economic Scenario Generators
- Asset-liability management
- Risk measures
- Financial economics

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Current Journals

- ASTIN Bulletin
- NAAJ
- IME
- Scandinavian Actuarial Journal
- Journal of Risk and Insurance
- European Actuarial Journal
- Annals of Actuarial Science

Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI

Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Part 3
How to write a research paper

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Disclaimer…

- Many very successful papers do not follow the suggestions in this talk.
- In some cases, ignoring good practice is **more** likely to get your paper accepted in a journal.
- But if it is **bad science** – then you are not doing your first duty…
- **Defend Science!!!**

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

The Greek art of persuasion

1. The Introduction
2. The Narrative
3. The Argument
4. The Refutation
5. The Conclusion

Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Parts of a scientific paper

1) Abstract
2) Introduction ; statement of question
3) Literature review (often included in 2.)
4) Definitions, notation, methodology
5) Analysis; results.
6) Supplementary results and discussion
7) Conclusion
8) References
9) Appendices

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Your research tells a linear story

» In the beginning

- What are you doing? Why? History

» In the middle

- Here's the work

» In the end

- Take away

» Although the narrative is linear, the writing usually isn't..

Canada OJK Otoritas Jasa Keuangan University of Waterloo

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Typical writing process

1. Identify the story
2. Produce the graphs, tables, mathematical equations that will tell your story. Keep notes!
3. Write the definitions/method section
4. Write the results section and technical appendices

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Typical writing process

5. Write the conclusions
6. Write the introduction
7. Write the abstract
8. Craft a good title

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Abstract

- The abstract should be a brief summary of the paper, including the main conclusions.
- It should be very concise.
- It is not intended to be an introduction.
- It may be vitally important – it is what persuades people to read and cite your work.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Introduction and literature review

- The significance of the topic
- The contribution you aim to make in your paper; relevance, significance and credibility.
- A literature review supporting the importance of the topic, the potential for contribution, and the validity of your methodology

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Introduction and literature review

- The literature review is a balance between coverage and conciseness.
- You should cite every paper relevant to your hypothesis.
- If in doubt, cite – but what you cite should be relevant and credible.
- Track back though cited papers to the originators of your chosen methods or results.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Methods

- Aim for complete transparency
- Use clear and intuitive notation
- Avoid using common notation out of place
  - Examples?
- Avoid using excessively complex notation
- Generally, prefer English to mathematics if it improves readability
  - E.g. use “for all $x > 0$” in place of “$\forall x > 0$”

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Results

- Report results neutrally.
- Don’t avoid bad news – e.g. misleading choice of results to show.
- Don’t overstate your results.
- Relate your work to the existing literature
- Identify and explain any surprising features of the results.
- Limitations of results may go here.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Conclusions

- This should be a short section
- The point is not to summarize results
- The point is to identify implications of results.
  - What should readers take away from this work?
- There may be some room for subjective discussion
  - Supported by the previous analysis.
- Limitations to the conclusions should be reviewed.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

End stuff

- References
- Appendices

Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Figures and Tables

» Figures can be very powerful.

- The captions should be explain the table or figure without having to search through the text.
- Not very helpful:

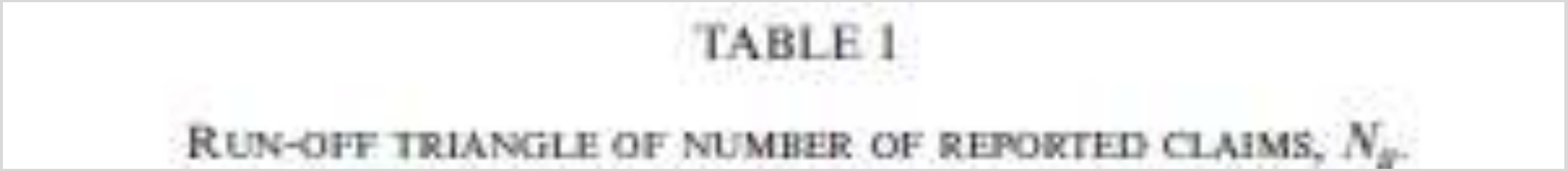


TABLE 1

RUN-OFF TRIANGLE OF NUMBER OF REPORTED CLAIMS, N_{ij}.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Figures and Tables

» More helpful:

FIGURE 1
Ungraduated Mortality Rates Above the Age of 60 for England and Wales Males for the Year 2002 (dots) and Fitted Curve $e^{A_1+A_2y}/(1+e^{A_1+A_2y})$ for $A_1 = -10.95$ and $A_2 = 0.1058$

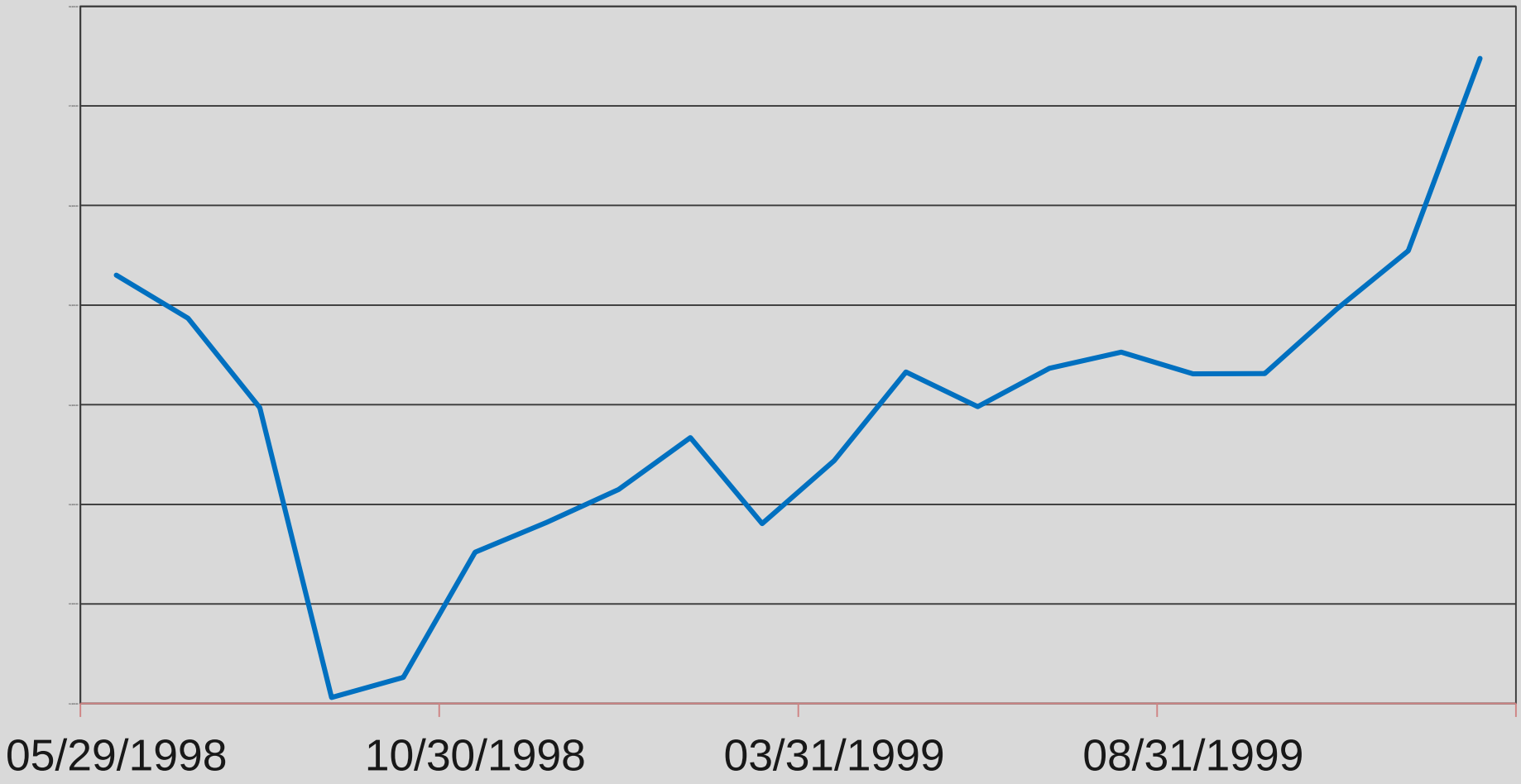
READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Other guidelines for graphics

- Don’t produce misleading graphics
  - Examples?
- Relate graph size to information content
- Integrate with text
  - When to put figures in appendix? When in line?
- Stay reader-focused

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

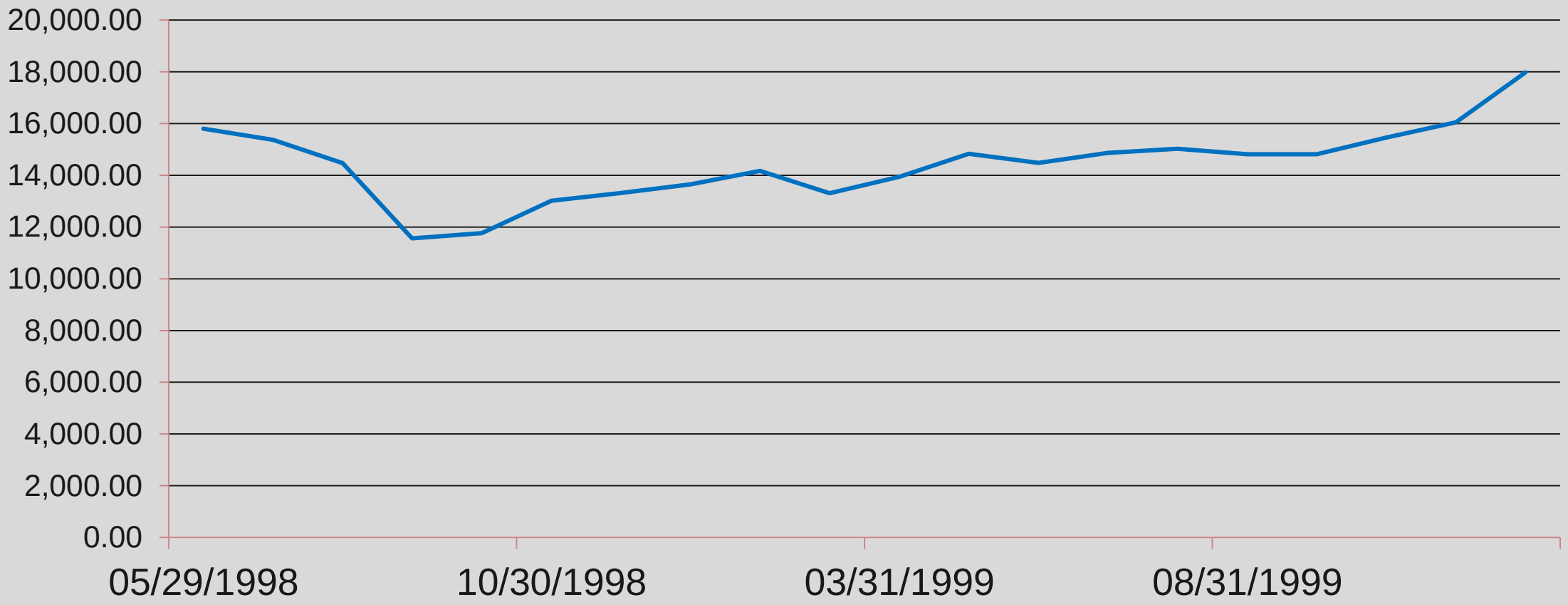
Big stock market crash in 1998?



Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

No, just y-abuse....



Canada
OJK OTORITAS JASA KEUANGAN
UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

General writing tips

- Identify the target journal before you start writing
  - Do not spend time on commonly known prior results or issues.
  - Use the language of your audience
    - For example, actuarial notation

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

General writing tips

- Define notation, technical terms and acronyms before you use them.
- Careful choice of notation can greatly improve readability.
  - Don’t use notation to make your work look more impressive and less accessible.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

General Writing Tips

- Keep sentences short.
- Aim for clarity, accuracy, conciseness.
- Use figures and graphics to tell your story wherever possible
  - “A picture tells a thousand words”

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

General writing tips

- you are writing in English, try to have a native English speaker review your writing.
- Avoid conjecture
  -
- Use “we” not “I”
- Use the ‘active voice’
  -

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

General writing tips

- Every sentence should be related to the sentence before.
- Every paragraph should flow from the paragraph before.
- If you are changing topic, open a new section. And explain how each section follows from the last one.

From Kim & Hardy

We have shown in this section that common estimators for quantile and CTE risk measures are biased in general. One method for estimating and correcting for bias is through the bootstrap technique.

4. THE BOOTSTRAP

4.1. Overview

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

General writing tips

- Avoid vague statements, e.g.

  "There has been increasing interest in the XYZ risk measure in actuarial practice"

  Better…

  "The XYZ risk measure has been applied to life insurance risk management by Smith and Jones (2015); Xu and Zhu (2016) describe broader applications in financial risk applications"

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Why do papers get rejected?

1. Inadequate knowledge of the topic
   - Limited literature review
   - Work shows lack of knowledge of literature
2. Not a sufficient contribution
   - Problem is not significant
   - Solution is not suitable
   - Topic is not sufficiently relevant to actuaries
   - Topic is too limited
3. Errors

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Research proposals

1. Introduction
   - Why is this an interesting problem?
2. Preliminary literature review
   - Demonstrate awareness of the literature
3. Objective
   - Try to be specific. Narrow focus.
4. First steps
   - Be specific.

READI

Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Part 4
Presenting Research

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

The Greek art of persuasion

1. The Introduction
2. The Narrative
3. The Argument
4. The Refutation
5. The Conclusion

Canada OJK OTORITAS JASA KEUANGAN UNIVERSITY OF WATERLOO

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Presentations are important!

- Presentations are a key part of actuarial research
  - Bridge to practitioners and other researchers
  - Feedback on research progress
  - Helps when work is submitted for publication
- Strong presentation requires
  - **High quality slide design**
  - **High quality delivery**

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Principles of Good Presentations

1. Define your purpose
2. Be user focused
3. State your key message, simply
4. Stay on topic
5. Be concise
6. Keep it simple
7. Prepare high quality materials

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Developing the presentation

1. Decide on your message
2. Be user-focused: know your audience
3. Get organized: tell a story
    - Start with an introduction – the most important part!!
    - Explain your story, make it interesting
    - Conclude
4. **Rehearse**

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Designing the visuals

- Try to keep slides uncluttered
- Usually, avoid equations, proofs
  - Use language, intuition
- Use key phrases in bullet points
- If the slides are used as an ongoing resource, the content will be more substantial.

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Designing the visuals

Don’t write everything you want to say on the slide and then read it. That’s very boring for the audience. They will switch off. In fact you should continually review your slides and your presentation from the perspective of your audience. What would you want to see in their place? How do you feel when people have a lot of script on a slide and just read it? You probably think about checking your phone until the next slide, right?

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Designing the visuals

- Tables of results are rarely useful in presentations
  - Convert to figures where possible
  - But make sure the figures are clear
  - Avoid using misleading figures
- Remove useless ink from slides
  - 3D effect, background colour, border, etc
- Be creative!

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Tips 2 – Effective Delivery

- Plan – especially the first 2 minutes
- Do not talk from a script
- Face your audience; use facial expression
- Use movement and gestures; try to be relaxed
- Pause frequently; speak slowly
- Dress appropriately
- Be aware of your posture and body language

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Tips 3 – Engaging the Audience

- Plan change points
  - Ask a question; ask for a show of hands
- Invite questions
  - keep on point
  - give feedback
  - paraphrase the question

READI
Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

Top 10 PowerPoint errors

1. Too much business on the slide
2. Too many words
3. Annoying animation
4. Reading the slide
5. Bad colours, font or design
6. Too many slides
7. Presenter never looks up or only looks at screen
8. Lack of interaction; static posture
9. Tables, formulas, details

READI

Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia

τΗΛηκ γθμ

Canada

OJK OTORITAS JASA KEUANGAN

UNIVERSITY OF WATERLOO