12th Webinar on Health Care Insurance

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Harnessing Intuitive Thinking for Actuarial problem solving

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A fun game: Guess the nationality

mentimeter.com
Menti quiz

How did we guess?

Intuitive thinking!

- Rapid decision making process
- Relies on instinct and “gut feeling”
- Automatic and subconscious
- Based on our past experience and knowledge

…however:

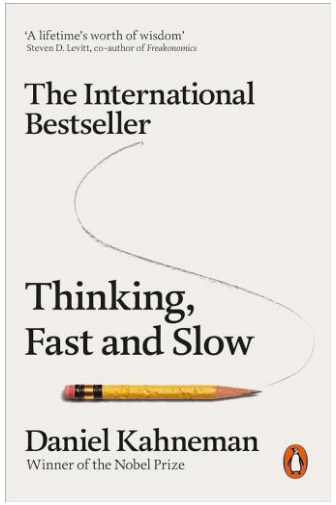
- Subject to bias without validation!

Intuitive thinking is fast, automatic, while analytical thinking is slow, contemplative

Intuitive thinking:

- Rapid decision making process
- Relies on instinct and “gut feeling”
- Automatic and unconscious
- Based on our past experience and knowledge
- Subject to indiviual “bias”!

SYSTEM 1



Analytical thinking:

- Deliberate decision-making process
- Relies on logic and systematic analysis
- Conscious and methodical
- Based on critical evaluation of data and evidence
- Slow and time-consuming process!

SYSTEM 2

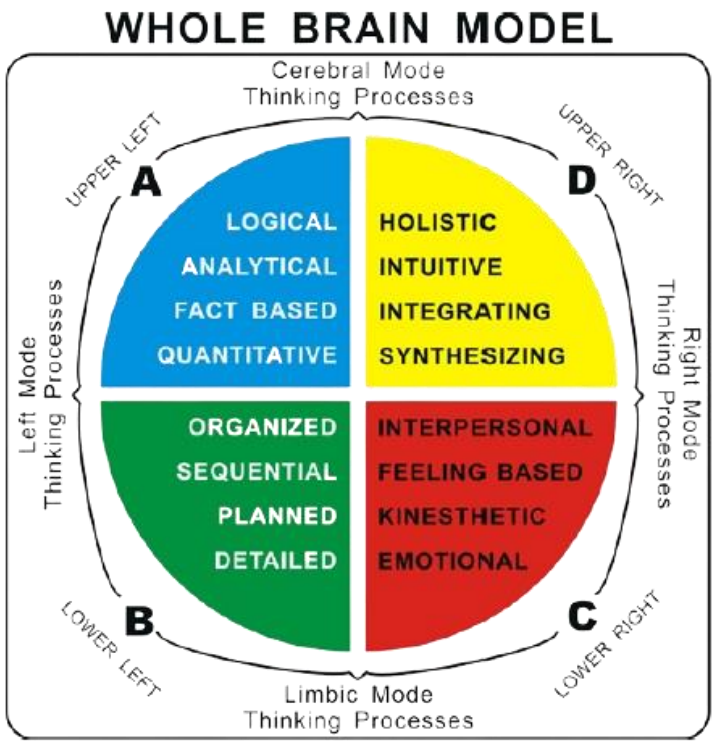
Medical research supports differences in human thinking processes

Electroencephalography (EEG) literature on theta and alpha brain rhythms support these two systems in human brain:

- **System 1** intuitive thinking is characterized by an increase in **parietal alpha EEG power** reflecting autonomic access to long-term memory and a release of attentional resources
- **System 2** analytical thinking is characterized by an increase in **frontal theta EEG power** indicative of the engagement of cognitive control and working memory processes

Different people are naturally more inclined to different thinking process: ranging from logical/ fact-based, holistic/ intuitive, organized/ detailed, emotional/ interpersonal etc.

Ned Herrmann



Driving through a sharp turn!

Can you do a maths problem like multiplication of 17 x 24, while driving a sharp turn in a mountain road? Or engage in a discussion on a serious topic with co-passengers? Possibly no, irrerspective of no. of years of driving experience!

WORK IN PROGRESS

Attention has a limited capacity

We can only allocate more of only one system of thinking in our brain: intuitive or analytical

- Intense focusing on one task can make people effectively blind!
    - World-famous awareness test from Daniel Simons and Christopher Chabris: **“Invisible Gorilla”**
- In Actuarial world: intense focus on the data analysis could make the actuary to miss the key objectives, practicality of the outcome and business relevance.

Invisible Gorilla experiment
(available on YouTube)

Example 1: Pricing

Example 1: analytical thinking

Advanced and granular pricing using statistical modeling

- A health product is priced using **advanced statistical models** to estimate the claims cost per insured.
- Separate models are built **for each different product cohorts**
- The model outcome provides the **predicted claims cost** per insured **for each rating factor** and **product combination**
- Stastical tests show a very good result:
  - **More than 99% accuracy** both in train and test data
  - **Backtested and validated** for **out-of-sample** data
  - Predicted vs. observed **for each rating factor** showing good fit, residuals well aligned with the normal distribution check
  - **AIC/ BIC** show no-overfitting of the model

Key highlights

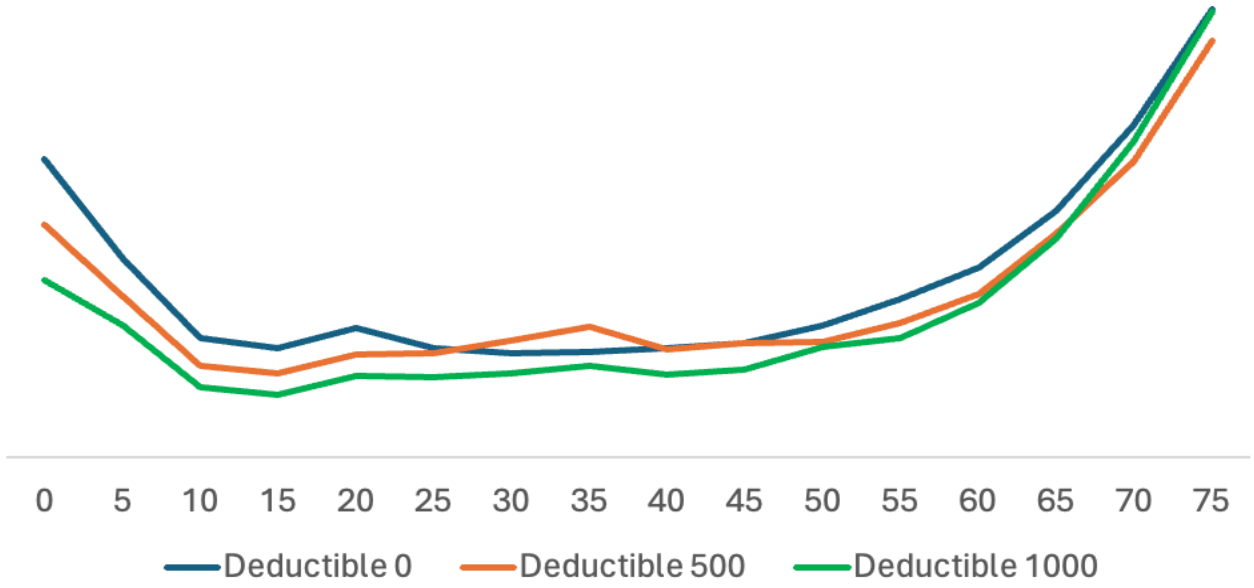
- The statistical model used in this case is **well tested across industry** and across lines of business.
- The methodology adopted includes the **best practices** and built upon **strong statistical foundation**
- The process is **well documented** for many years, reviewed by senior actuaries and have been implemented following the guidelines that is set out

Nothing could go wrong in estimating the claims cost through such a well followed pricing process!

Example 1: intuitive thinking

Comparison of the CPI (Cost per Insured)

For a reference customer profile (same gender, region) and product combination, predicted cost per insured compared by age and deductible level:



Key highlights

- Outcome not intuitively explained: higher deductible is expected to have higher out-of-pocket payment, decreasing the severity (possibly also frequency), therefore reducing the CPI.

<u>Potential problems undetected by models:</u>

- Type and profiles of customers are very different in different product options
- Types of claims generated for different age groups are not similar
- Deductible differences are not enough to make the cost differentiation

Question to consider: What would be the impact on customer and product, due to such inconsistency?

Ethical responsibility of Actuaries can't be ensured only through analytical methods

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- Unlike other lines of insurance, Health insurance has a **direct and significant impact on the human life** in accessing necessary medical care.
- **Access to healthcare** is often seen as one of the **fundamental human right**
- **Fairness and equity** should be ensured beyond the data analysis
- Actuaries should think about the moral responsibility that pricing practices do not contribute to **greater societal inequities**

Points to consider: Some examples

Use of certain rating factors	Example: street level address details for geographical region
Repricing practices	Practices such as claims-based repricing on individual customer level
Avoiding certain risks	Example: significant high increase of elderly premiums even if they are insured for long time

Advanced analytics should be supplemented with human judgement and ethics, which is particularly very important in Health Insurance

Example 2: Product development

Launching a new product

Objective: design and launch a new dental product

- New dental product in a country where no such product exists previously

Potential key steps:

Market research and desktop analysis

- Demand for such product in market
- Identify and define target customer segments
- Regulatory contraints and needs

Product Design and Pricing calculation

- Product features, risk assessment, compliance
- Guarantees and options, cost containment
- Calculation of premiums- technical, commercial

Pre-launch readiness

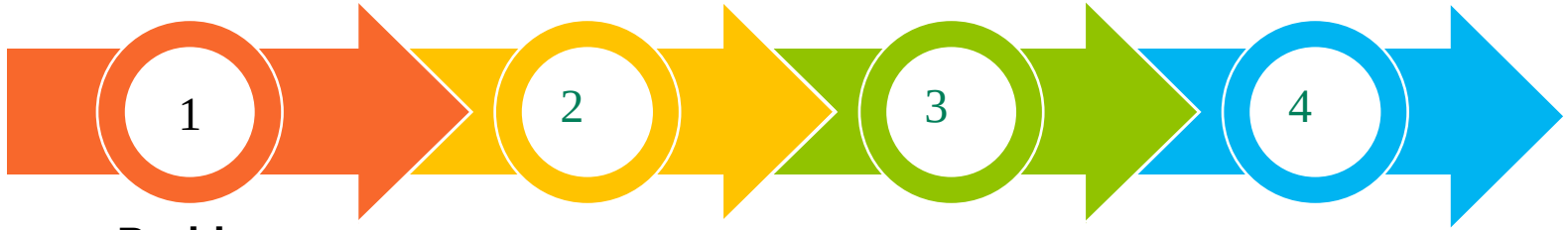
- Regulatory approval: as per market requirements
- Operational readiness (IT and systems, trainings etc.)
- Distribution strategy, Marketing, launch plan
- Sales brochure, customer engagement strategy

Key highlights

Challenges in relying only on data-driven analytical thinking:

- **No or little detailed data** to support market research and analysis
- **Lack of detailed and accurate pricing** due to absence of claims experience data
- Some **product features** might be **problamatic** with respect to anti-selection, subjectivity
- Some product plans might not be sold at all, due to **wrong analysis of demand** if relied on data inputs only

Toolsets for problem solving including intuitive and analytical thinking



Problem identification

*Ask **"what"** problem to solve and **"why"** we are doing it? This is the "**north-star**"!*

Split the problem

***Break down the problem** into smaller, manageable parts*

Hypothesis generation

***Generate a hypothesis** what could be the issue behind this part of the problem?*

Validation by analytical part

*Use **analytical thinking to validate** the initial hypothesis and move to next hypothesis*

Decision making

Reconcile the outcome with the problem objective and make a **decision** through balancing intuitive and analytical thinking

Example 3: Claims management

Hypothesis building in developing a fraud model

Developing a provider fraud, waste and abuse model

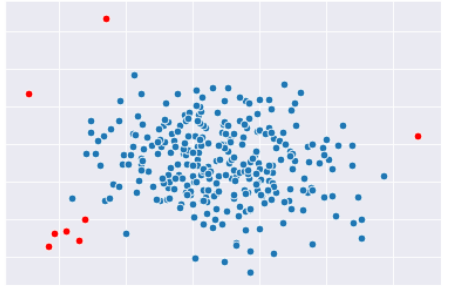
Key objective and the problem: build a new model to identify the possible fraud, waste and abuse in Health insurance claims.

How to start?

- Build hypotheses what could affect a claim to be fraudalant, for e.g.:
  - **Hypothesis 1:** *Providers who frequently bill for high-cost procedures might be engaging in upcoding*
  - **Hypothesis 2:** *Patients receiving an unusually high number of procedures or services in a short time frame might indicate abuse*
  - **Hypothesis 3:** *Providers with a high number of claims per patient relative to peers might be involved in fraudulent activities*
- Translate Hypotheses into Data Features
- Validate hypotheses with data: initial exploratory data analysis
- Model development and evaluation, implement, monitor and fine-tune

Key highlights

- A statistical or machine learning model to detect outliers may not be the first choice to identify the fraud, waste and abuse.



- **Unsupervised learning models** can identify anomaly or outliers, but unrestricted models may **increase the false positive** cases significantly leading to customer complaints and additional operational efforts.
- A combination of intuitive and analytical thinking to develop a balance between "***what is expected***" and an automatic model would lead to the best outcome.

Example 4: Claims development

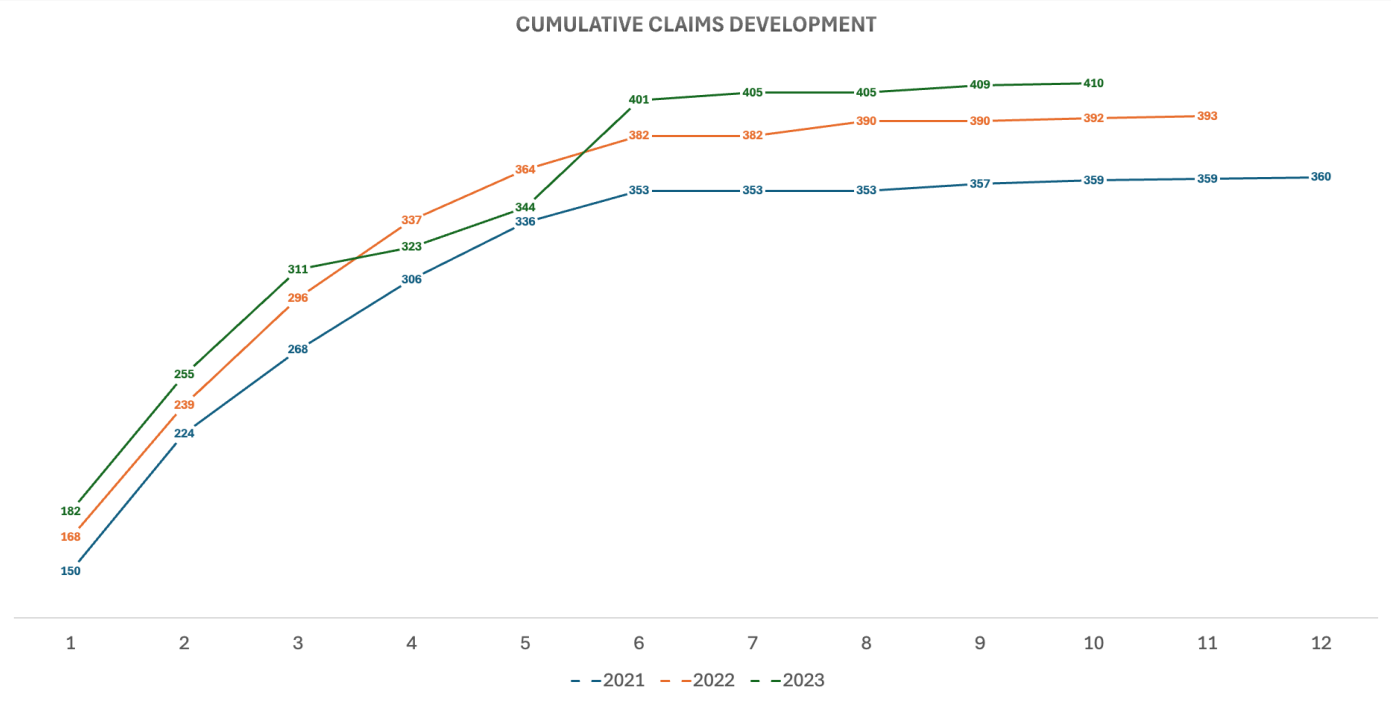
Processing complex information

Presentation 1

Cumulative claims by occurrence year

	Occurrence Year		
Quarters	2021	2022	2023
1	150.0	168.0	182.0
2	223.5	238.6	254.8
3	268.2	295.8	311.0
4	305.7	337.2	323.0
5	336.3	364.2	344.0
6	353.1	382.4	401.3
7	353.1	382.4	405.3
8	353.1	390.1	405.3
9	356.7	390.1	409.4
10	358.5	391.6	410.2
11	359.2	392.8	
12	360.2		

Presentation 2

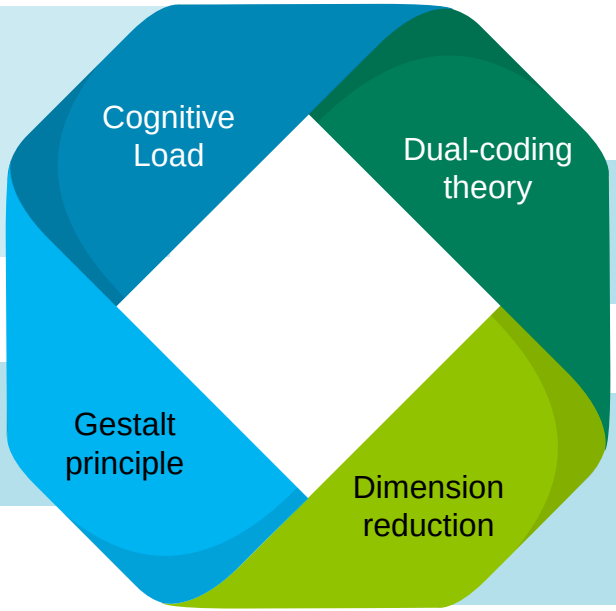


Visualization helps in quicker apprehension of the information and problem

Dimension reduction helps the brain to process better and retain

Visual representation **reduce cognitive load**: amount of mental effort in the working memory

Charts can utilize Gestalt **principles of perception**, such as proximity, similarity, and closure



Allan Paivio: Brain processes visual and verbal **information through separate channels**

Complex **high dimensional data is difficult to process**, pattern recognition is hampered

How to develop “intuitive thinking”?

Developing intuition and cognitive expertise needs long-term, deliberate practice

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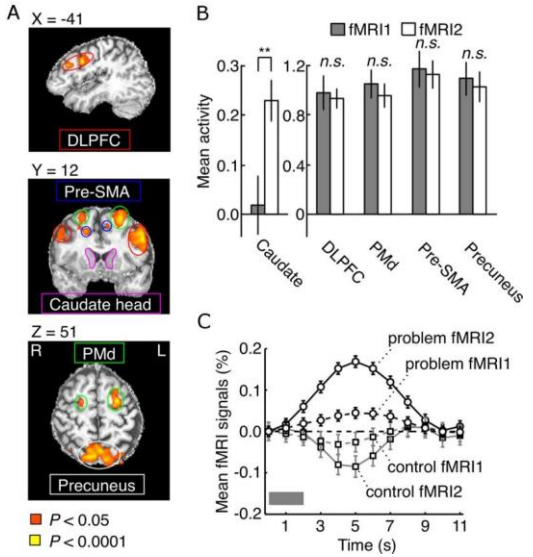
A neurscience study on developing intuition

- Cognitive experts have superior capability of problem solving in various domains: including board games, mathematics, medical diagnoses etc.
- A selected group of young people were studied, who learnt shogi (a Japanese Chess game) without any prior knowledge, to assess if training can affect intuition of quick generation of the best next-move.
- 2 Functional MRIs (fMRI) was used to assess the brain regions at the start of the study and at the end, including dorsolateral prefrontal cortex, Caudate head, praecuneus etc. as the professionals have a better intuition in the game than amateurs due to activation in the head of caudate nucleus.



Key highlights

- The studies showed that a close relationship between the performance in the quick generation of the best next-move and caudate head activity was not present after the initial training (until fMRI1) but **developed during the training** between fMRI1 and fMRI2.
- **Intuition can be further improved** through long-term, extensive and meaningful training**.** Learnings from the analytical thinking are stored for intuitive thinking to be used in long-term.

Summary

- Actuaries need to be “conscious” of two systems: analytical and intuitive thinking

- Intuitive thinking can support, and supplement detailed analytical thinking in situations:
  - **Validation** of the outcome from analytical thinking
  - **Lack of data situations** where analytical thinking might be biased or not credible
  - Essential **ethical or moral** judegments

- Analytical thinking can supplement the intuitive thinking:
  - In **removing any personal bias** from the conclusion
  - **Enhancing the accuracy** of the solution and **fine-tune the intuitions** in the long-term

- The best outcome is obtained by **blending both the systems** instead of fully relying on either only

- **Continuous learning and applications** strengthen the inutitive thkinging, asking “what” needs to be solved and “why” will help to further strengthen the answer to “how” it can be solved.