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L'intelligenza artificiale e' intelligente come pensa di essere?

Is Artificial Intelligence
As Intelligent As It Thinks?

Why start a talk in Italian?

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Why start a talk in Italian?

♦ It helps get your attention even while you're eating dinner.

♦ It emphasizes we make assumptions (like an English talk), and base predictions on them, but we aren't always accurate.

  ▪ Most people expect a talk at ATPESC to be given in English. It is highly likely, but not certain.

  ▪ Helps us consider how humans make decisions.

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Why an Economist?

♦ What can someone trained in econ and finance possibly say about AI that is useful to tech experts like you? Social scientists:

- Have an inclination to ask how human beings think/act, and question the impacts on the models we create (like AI).

- Analyze methods and their foundations for strengths and weaknesses.

Our Goals Tonight

♦ The opening question about AI's intelligence is useful as a way to focus on qualities used to formulate AI.

- How well do humans model & predict?
- Can AI algorithms do better and do they have potential shortcomings?

   But First: what do we mean by AI?

AI

♦ Many varying definitions.

♦ Tonight's view geared toward machine abilities to analyze data, and make predictions. (decisions?)
  ▪ With a focus toward the underlying algorithms.

Our Starting Point

♦ Consider briefly how humans analyze data and make decisions.
  ▪ How logical/rational are we?
♦ Do/can machines do better than humans?

How Humans Decide

♦ Human theories, analyses, and decisions draw upon beliefs, assumptions, and historic data to attempt to predict the future.

- In many instances people analyze well and outcomes are good.
- In some situations, use of heuristics (simple time-saving rules) can lead to poor results.

How Humans Decide

♦ Some methods humans use (like heuristics) are prone to biases.

- The term bias refers to incongruities.
- Many of these can be predicted.
  ❖ Psychology and behavioral science.
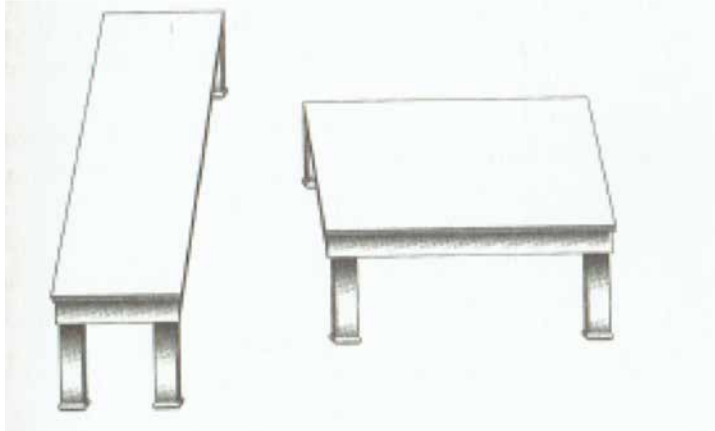   ● Richard Thaler's 2017 Nobel Prize.

How Humans Decide

♦ It is hoped that by looking at predictable human biases we may better understand their impact on the underlying frameworks for the models we create.
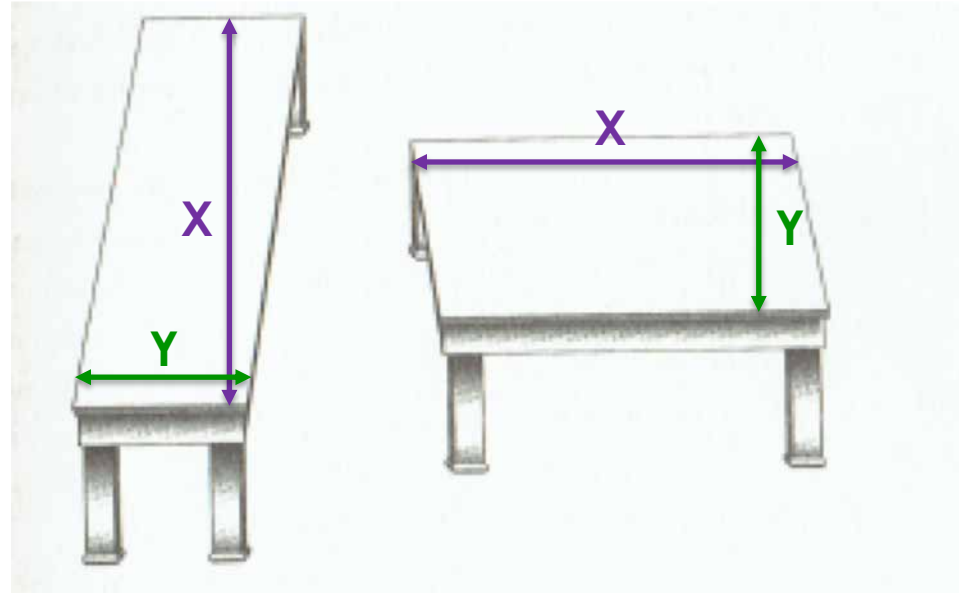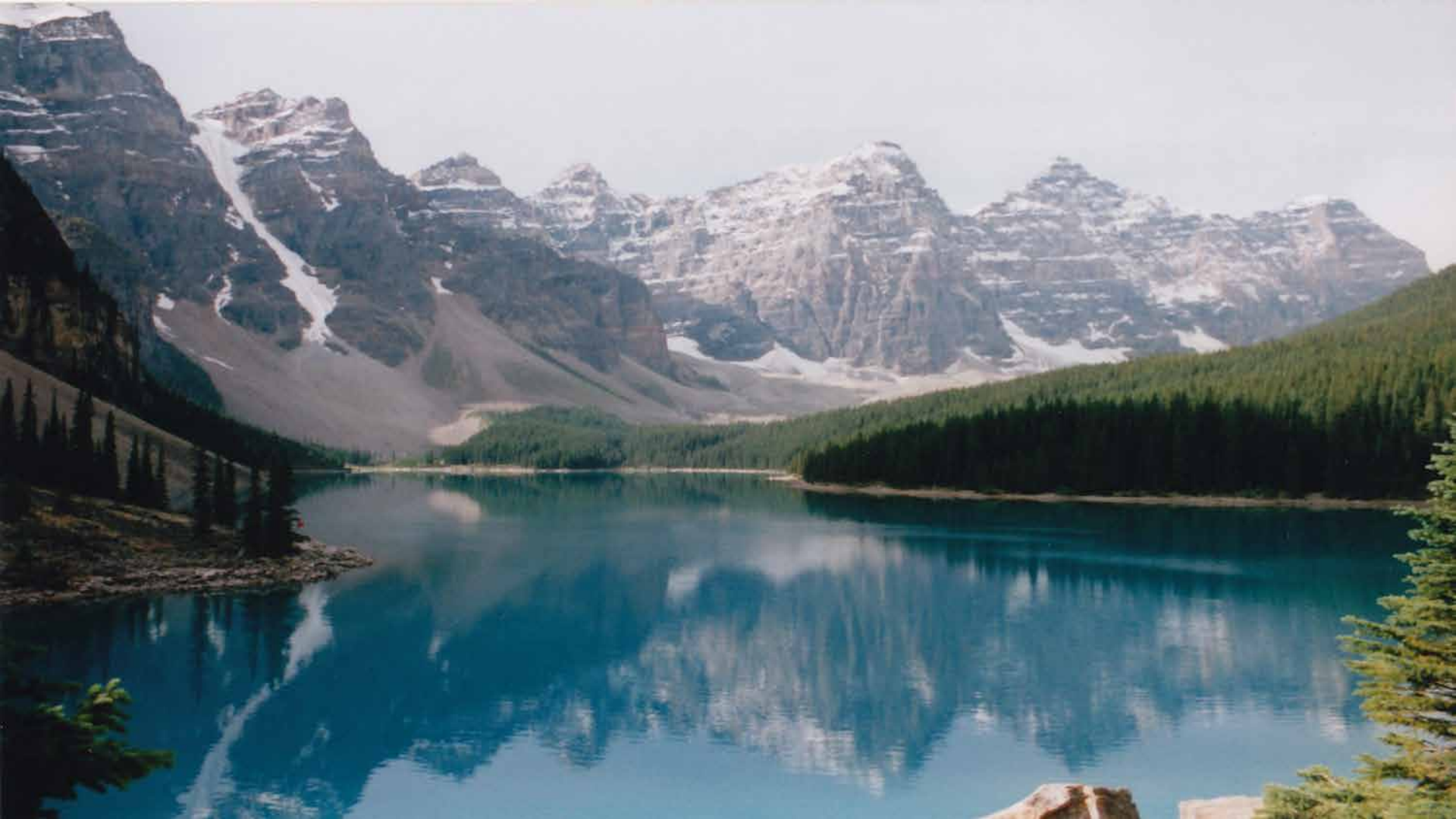
Predictable Human Biases

Which table is longer and which is wider?

Predictable Human Biases

♦ Most people choose the first table as longer and the second wider.

- Both are the same size, but many people are certain they differ.
- The bias can be avoided by measuring both.
  - ❖ Automated measuring avoids the bias.
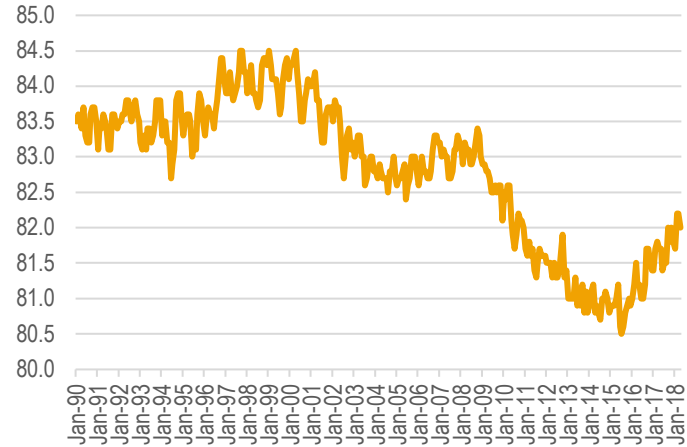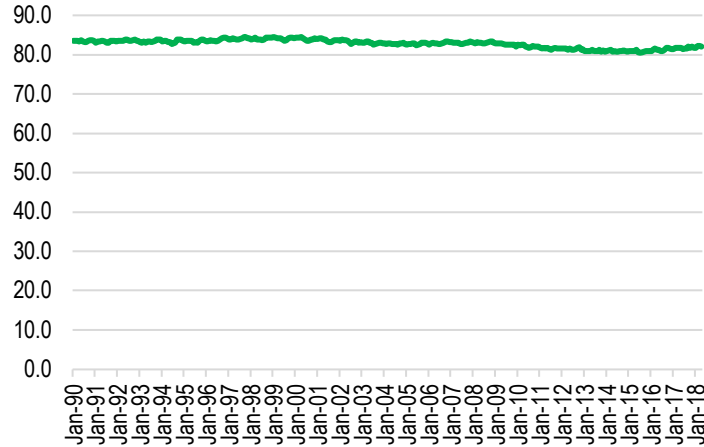
Predictable Human Biases

Predictable Biases

♦ There are many instances where humans can be fooled, but unbiased algorithms consistently applied to data are not.

♦ The following shows another case where people are often fooled.

Predictable Biases

Labor Participation Rate: Ages 25-54

Same data, different scales
Data from Bureau of Labor Statistics website.

Biases & Forecasting

♦ Given our biases, how good are human forecasts?

  ▪ Experts predict worse than simple models.

    ❖ Overconfident, inconsistent, and expect more exceptions than observed (overconfidence bias).

    ❖ Not good at revising forecasts in light of changing data (status quo bias).

      • A big problem in project management.

Political Forecasting Evidence

- P. Tetlock (Penn) interviewed 284 political-economic experts (80,000 predictions).
  - Performed worse than if equal probabilities assigned to the three outcomes requested.
  - Most experts had difficulty admitting error.
  - The most famous experts were more overconfident with less accurate predictions.

Biases & Forecasting

♦ Models based upon expert's rules.

- Predict better than most experts upon whom they are based.

  ❖ The algorithms are consistent, adapt better to incremental changes in data, and reflect collective judgments of the best predicting experts.

  - Averaging probabilistic thinking by the experts in algorithms gives the best results. The algorithms do not provide the probabilities upon which they are based. How might AI derive probabilities for instances where there is limited or no data?

Biases & Financial Decisions

- ◆ How good are our investment decisions?
  - ▪ Most people have poor performance.
    - ❖ Most investment returns are worse than the "market".
      - Over optimism, fear, and greed lower overall results.
    - ❖ Terrance Odean's (Berkeley) analysis.
      - 10,000 individual brokerage accounts, ~163,000 trades.
      - On average after trading costs, shares sold did better than those bought by 3.2% per year (with random results and no bias they would be about equal).

Biases & Financial Decisions

♦ And the experts?

- Professional traders do better than individual investors, but 70% - 80% still underperform the "market"*.

- Top experts using algorithms with HPC have also failed.

  ❖ Long Term Capital Management.

  * averages represented by indices.

Biases & Financial Decisions

♦ How About Using AI?

▪ A recent article examines the impact of using machine learning with decision trees and neural nets to predict stock prices*.

❖ The authors conclude "that machine learning offers an improved description of asset price behavior [stocks] relative to traditional methods".

* Shihao Gu, Bryan T. Kelly, and Dacheng Xiu, "Empirical Asset Pricing via Machine Learning," Working paper, April 2018. Examines 30,000 stocks traded between 1957 and 2016.

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Human v. Machine

♦ Humans have biases that affect their decisions in predictable ways.

♦ Machines can improve results.

- Able to avoid some common human biases.
- Predictable biases are left out of the process.

Human v. Machine

♦ Does that mean AI is free from bias?

▪ It is reasonable to ask:

❖ Are the assumptions free from bias?

❖ Is the model's framework free from bias?

❖ Is the data free of bias?

❖ Do the programs ignore all human biases?

▪ And reasonable to note:

❖ The algorithms and the models come from humans.

Finance Example

- ♦ Estimate the future value of a stream of payments.
  - ▪ Affects everyone with a defined contribution or defined benefit retirement plan.
    - ❖ A complex problem where the answer has significant impact on retiree well-being .

Estimating Future Value

♦ Most models start by looking at data for past returns and extrapolating forward.

  ▪ Which data is best as a basis for modeling?

    ❖ The accuracy and consistency of the data can change in different time periods for many reasons.

      ● Measurement methods.

      ● Company changes in the indices.

      ● Other factors.

Estimating Future Value

♦ Projections change significantly depending on the data selected as the basis for estimates.

   ❖ Average returns and variations for returns can differ markedly.

   ❖ Different periods are influenced by many factors, including starting and ending points of the data set relative to business cycles and relative asset prices.

Estimating Future Value

- ♦ What outcomes are possible?
  - ▪ Using different historic data as the basis for modeling the future can show significantly different retirement savings outcomes* (hundreds of thousands of dollars or more) depending on the time period selected.
    - ❖ *For a worker with an average income, who saves 8% of salary per year (including employer contributions) over 30 years.

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Using AI to Estimate

♦ Can AI help?
- It can operate without emotions or biases born from fear, greed, over optimism, ...
- As you know, AI can analyze a lot of data, look for correlations, test fits of data between time periods, assign probabilities, use simulations, adjust as new data becomes available, etc. But . . .

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Using AI to Estimate

♦ The starting point of data for past returns can still introduce bias.

  ▪ Fundamental changes in the economy can occur where the past is not a good indicator of the future (like disclaimers).

  ❖ Trends not yet recognized or easily predicted.
    • Technological changes, devastating war, etc.

  ❖ Black swan events.
    • Events and non events that are difficult to anticipate.

Using AI to Estimate

♦ The data itself can introduce bias.

- Quantitative Bias
  - ❖ The ability to accurately measure returns can change over time and skew results.
  - ❖ Spurious correlations occur. How to distinguish?
  - ❖ Focusing on measurable variables, quantitative v. qualitative data. A bias?
    - How much is needed for the "proper" retirement lifestyle?
  - ❖ Can impact all analysis including AI.

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Can Quantitative Measures Tell Which is More Beautiful?

What Does It All Mean?

♦ The general modeling and data issues described are not unique.

■ They are applicable to natural science and other applications.

Conclusions

- There are many advantages of AI.
  - The ability to analyze more data, more accurately, and more efficiently.
  - Minimizing human biases in implementing models and forecasts.
    - Not as prone to optimism bias, status quo bias, etc.

Conclusions

♦ And some shortcomings.

- Fundamental structural changes may not be captured well by the models.
  - ❖ "Revolutions" in scientific thought/theory.
- Data problems can still exist.
  - ❖ Measurement errors, spurious correlation, etc.
- Algorithm constraints and biases.

Back to Our Opening Question

♦ Is artificial intelligence as intelligent as it thinks it is?

   ▪ I conclude it is not. Why?

   ▪ Simply because it is still far from perfect due to the human element. Humans:

      ❖ Write the algorithms upon which AI is based.

      ❖ Are susceptible to biases for the methods we create, including AI.

Special Thank You

Thanks to the following people for helping me think about and refine tonight's presentation.
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