计量经济学STAT30021

第一讲：计量经济学简介

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复旦大学管理学院统计与数据科学系

2025年9月

陆奇：技术，价值与机会

2021年5月，奇绩创坛创始人兼CEO陆奇博士回母校复旦大学做了主题演讲，分享了他对当下很多问题的观点。

https://www.163.com/dy/article/GGQGGIF405418T7D.html

陆奇：技术，价值与机会

陆奇：技术驱动时代，迎来史上最大市场机会，我们如何创造价值?

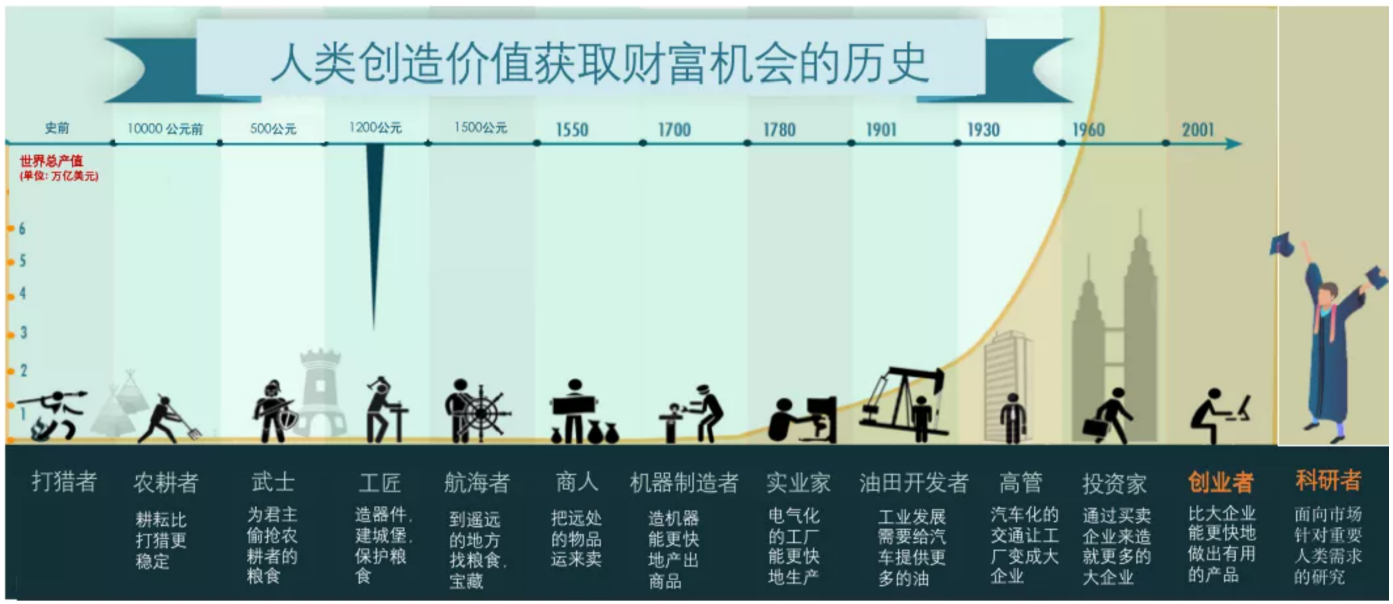
2021-08-07 16:37:06　来源: 博士候　　举报

“在校期间，不管你是什么专业，更重要的是学习思考的方法。我在雅虎，雇了3000 多名工程师，在微软，我的团队有14000多名工程师，据我的观察，你在学校里面学的东西，大概率在工作当中基本用不到。更为重要的是在学校中锻炼学习的方法和思考的能力。”

陆奇：技术，价值与机会

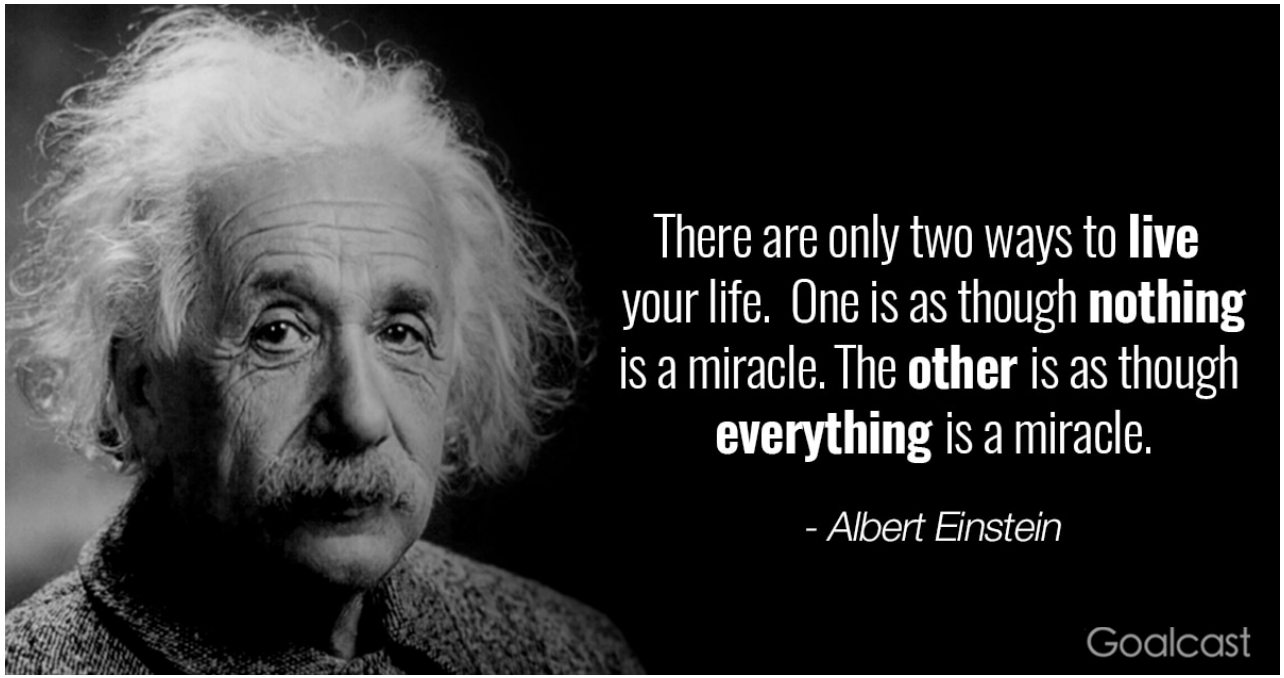
人类社会每一个大的时代，都对应着一个标志性的新兴技术。当前的时代，标志性的新兴技术是什么呢？

技术驱动创新所带来的职业选择趋向



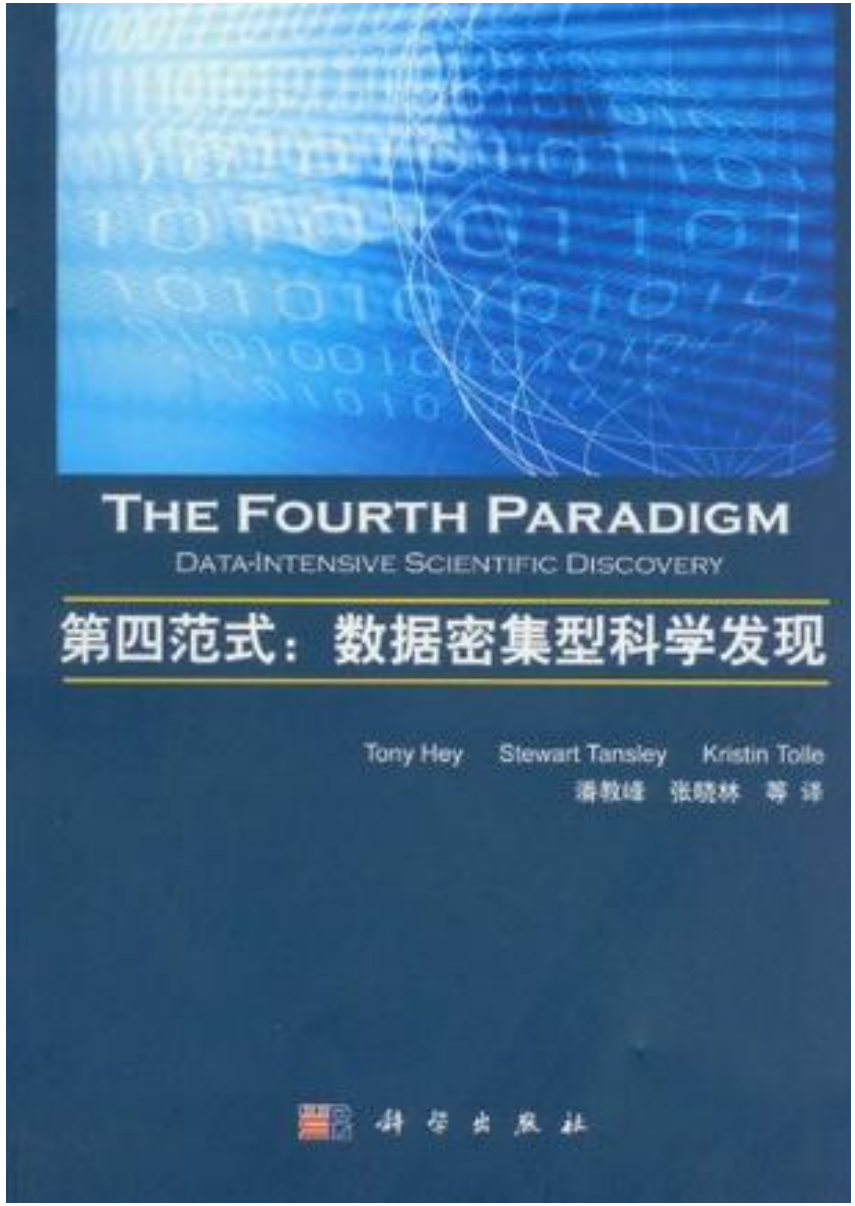
“当时看到这张图，我就在想：下一个创造财富最多的职业是什么？对我来讲，毫无疑问是科研（科学研究），特别是用新的范式做科学研究，也就是基于第四范式”

爱因斯坦：什么是（现代）科学研究？

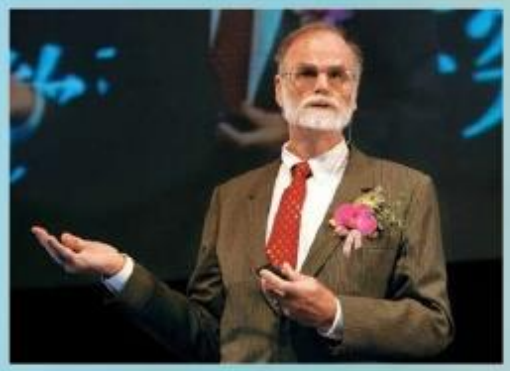


Development of Western science is based on two great achievements: **the invention of the formal logical system** (in Euclidean geometry) by the Greek philosophers, and **the discovery of the possibility to find out causal relationships by systematic experiment** (during the Renaissance).

什么是第四范式？


THE FOURTH PARADIGM
DATA-INTENSIVE SCIENTIFIC DISCOVERY
第四范式：数据密集型科学发现
Tony Hey
Stewart Tansley
Kristin Tolle
潘教峰 张晓林 等 译
科学出版社

图灵奖获得者吉姆格雷：数据驱动的科学发现-科学研究的第四范式



- *An "exaflood" of observational data requires a new generation of scientific computing tools*

  – Jim Gray

http://fourthparadigm.org

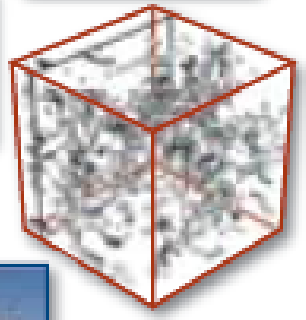
The
FOURTH
PARADIGM

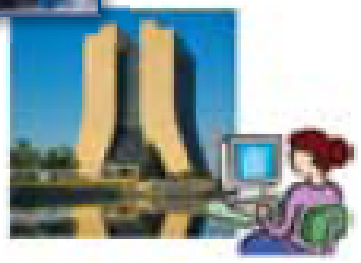
DATA-INTENSIVE SCIENTIFIC DISCOVERY

Science Paradigms

- Thousand years ago:
  science was **empirical**
  describing natural phenomena
- Last few hundred years:
  theoretical branch
  using models, generalizations
- Last few decades:
  a **computational** branch
  simulating complex phenomena
- Today: **data exploration** (eScience)
  unify theory, experiment, and simulation
  - Data captured by instruments or generated by simulator
  - Processed by software
  - Information/knowledge stored in computer
  - Scientist analyzes database/files using data management and statistics

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{4\pi G\rho}{3} - \mathrm{K}\frac{c^2}{a^2}$$





Originally, there was just experimental science, and then there was theoretical science, with Kepler's Laws, Newton's Laws of Motion, Maxwell's equations, and so on.

Then, for many problems, the theoretical models grew too complicated to solve analytically, and people had to start simulating. These simulations have carried us through much of the last half of the last millennium.

At this point, these simulations are generating a whole lot of data, along with a huge increase in data from the experimental sciences.

People now do not actually look through telescopes. Instead, they are "looking" through large-scale, complex instruments which relay data to datacenters, and only then do they look at the information on their computers.

The world of science has changed, and there is no question about this. The new model is for the data to be captured by instruments or generated by simulations before being processed by software and for the resulting information or knowledge to be stored in computers. Scientists only get to look at their data fairly late in this pipeline. The techniques and technologies for such data-intensive science are so different that it is worth distinguishing data-intensive science from computational science as a new, fourth paradigm for scientific exploration.

关于第四范式

第四范式（也就是数据驱动的科学研究范式）的出现是数据、算法和算力积累到一定阶段的产物。

这是一种由于技术推动而产生的新的科学探索的方式。

尽管这种新的研究范式近年来非常流行，但事实上这种范式对应用场景的要求是很严格的，在大部分场合它仍然无法替代传统的第一第二第三种研究范式。

当然，如果运用合适的话，它至少可以作为传统的以理论模型和逻辑演绎为主的研究范式的一个重要的辅助工具。

本课的目的就是帮助大家理解和掌握在社会学科领域，尤其是经济管理领域，如何做好数据驱动的科学研究。

社会科学研究方法归类：定性与定量

社会科学的研究方法分为定性研究和定量研究。

在计算机、电子化数据和算法软件普及以前，定性研究是社会科学的主流方法。定性研究方法通常有观察法、调研、访谈、案例研究等。

在计算机、电子化数据和算法软件普及以后，定量研究开始越来越流行。定量研究方法通常有基于数据的传统统计建模方法以及最近几年比较流行的机器学习算法等。

定性研究和定量研究

哈佛大学社会学Mary Waters教授和威斯康星大学麦迪逊分校Nicole M. Deterding 在社会学方法论顶刊Sociological Methods & Research的2021年第2期，发表了一篇文章《深度访谈的灵活编码：21 世纪的取向》（Flexible Coding of In-Depth Interviews: A Twenty-First-Century Approach）。

Article

Flexible Coding of In-depth Interviews: A Twenty-first-century Approach

Sociological Methods & Research
2021, Vol. 50(2) 708-739

DOI: 10.1177/0049124118799377
journals.sagepub.com/home/smr
SAGE

Nicole M. Deterding[1] and Mary C. Waters[2]

该论文作者们结合自己数十年的访谈研究经验，对定性方法问题意识和工作方法提出质疑，进一步倡导要用计算机软件辅助编码，建立数据库、兼顾灵活和规范的编码程序。https://finance.yiewan.com/news-id-113146.html

计量经济学

经济管理领域的第四范式的研究方法，或者说该领域的数据驱动的定量研究方法（数据的分析理论），我们称作计量经济学（Econometrics）。

具体地，计量经济学旨在基于数据分析来回答诸如下面一些典型的问题：

1. 估计经济变量之间的相关关系
2. 估计经济变量之间的因果关系（比如：评价宏观与微观政策的效果）
3. 分析因果关系传递的途径
4. 检验经济学理论的正确性

示范问题一、性别与创新能力差异

学术研究能力是否存在明显的性别差异？(American Economic Review, 2025)

Innovative Ideas and Gender (In)equality

Marlène Koffi

AMERICAN ECONOMIC REVIEW
VOL. 115, NO. 7, JULY 2025
(pp. 2207–36)

Download Full Text PDF

Article Information

Abstract

This paper analyzes recognition of women's innovative ideas compared to men's using bibliometric data in economics, mathematics, and sociology. I establish similarities between papers to construct relevant counterfactual citations. On average, all-female papers receive 10 percent fewer citations than all-male papers, a disparity reduced by 40 percent when considering team sizes and disappearing in most fields with authors' publication records. Additionally, strong in-group preferences emerge: All-male teams omit more papers with women, and vice versa. Accounting for publication histories, female scholars are cited 0 percent (economics) to 11 percent (mathematics) less, with early-career women enduring a 9–14 percent citation penalty.

示范问题二、科举制与社会稳定

科举制的取消是否造成了（短时间内的）社会不稳定？(Econometrica, 2016)

Econometrica, Vol. 84, No. 2 (March, 2016), 677–733

ELITE RECRUITMENT AND POLITICAL STABILITY: THE IMPACT OF THE ABOLITION OF CHINA'S CIVIL SERVICE EXAM

BY YING BAI AND RUIXUE JIA[1]

This paper studies how the abolition of an elite recruitment system—China's civil exam system that lasted over 1,300 years—affects political stability. Employing a panel data set across 262 prefectures and exploring the variations in the quotas on the entry-level exam candidates, we find that higher quotas per capita were associated with a higher probability of revolution participation after the abolition and a higher incidence of uprisings in 1911 that marked the end of the 2,000 years of imperial rule. This finding is robust to various checks including using the number of small rivers and short-run exam performance before the quota system as instruments. The patterns in the data appear most consistent with the interpretation that in regions with higher quotas per capita under the exam system, more would-be elites were negatively affected by the abolition. In addition, we document that modern human capital in the form of those studying in Japan also contributed to the revolution and that social capital strengthened the effect of quotas on revolution participation.

示范问题三、制度改变与企业行为

国内竞争法规出台对企业海外交叉上市行为的影响(JIBS, 2025)

Home › Journal of International Business Studies › Article

Product market bonding and cross-listings: evidence from global competition law reforms

Published: 02 October 2024

Volume 56, pages 311–335, (2025) Cite this article

In recent years, the phenomenon of "cross-listing" (listing a company's shares on a foreign stock exchange in addition to its home country's exchange) has become increasingly common. This trend has sparked interest among researchers trying to understand why companies take this step. While some theories suggest that cross-listing helps companies access more capital or signal strong corporate governance (the system by which companies are directed and controlled), there's a puzzle: even firms that are not in need of capital often cross-list. This suggests that there might be other reasons for cross-listing that existing theories don't fully explain.

This study introduces the idea of "product market bonding" as a new reason for cross-listing. The researchers propose that companies might cross-list in foreign markets as a strategic move to strengthen their position in those markets, especially when their home markets become more competitive due to stricter competition laws (rules designed to prevent anti-competitive practices and encourage fair competition). When these laws get tougher, companies might find it harder to maintain their market share and profits at home, so they look to foreign markets for growth.

To test this theory, the researchers used a dataset that includes cross-listing information from 56 home countries and 45 host countries. They focused on how changes in competition laws in a company's home country influenced its decision to cross-list. The study is observational and uses a method called "difference-in-differences" (a statistical technique used to determine the effect of a treatment by comparing the changes in outcomes over time between a treatment group and a control group) to compare the behavior of firms before and after competition law reforms.

示范问题四、机器学习算法与信贷歧视

机器学习算法是否对特定人群的金融信贷存在系统性歧视？(Journal of Finance, 2022)

The Journal of FINANCE
The Journal of THE AMERICAN FINANCE ASSOCIATION

THE JOURNAL OF FINANCE • VOL. LXXVII, NO. 1 • FEBRUARY 2022

Predictably Unequal? The Effects of Machine Learning on Credit Markets

ANDREAS FUSTER, PAUL GOLDSMITH-PINKHAM, TARUN RAMADORAI, and ANSGAR WALTHER

ABSTRACT

Innovations in statistical technology in functions including credit-screening have raised concerns about distributional impacts across categories such as race. Theoretically, distributional effects of better statistical technology can come from greater flexibility to uncover structural relationships or from triangulation of otherwise excluded characteristics. Using data on U.S. mortgages, we predict default using traditional and machine learning models. We find that Black and Hispanic borrowers are disproportionately less likely to gain from the introduction of machine learning. In a simple equilibrium credit market model, machine learning increases disparity in rates between and within groups, with these changes attributable primarily to greater flexibility.

示范问题五、企业对竞争对手行为的反应

企业会因为竞争对手披露重要信息而采取类似行为吗？(The Accounting Review, 2023)

Do Firms Respond to Peer Disclosures? Evidence from Disclosures of Clinical Trial Results

Vedran Capkun; Yun Lou ; Clemens A. Otto ; Yin Wang

+ Author & Article Information

The Accounting Review (2023) 98 (3): 71–108.

https://doi.org/10.2308/TAR-2019-0137

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Using data on the registration of clinical trials and the disclosure of trial results, we examine how firms respond to peer disclosures. We find that firms are less likely to disclose their own trial results if the results of a larger number of closely related trials are disclosed by their peers. This relation is stronger if the firms face higher competition (as measured by the number of competing trials). It is weaker if the firms are further along in their research than the peers (as measured by the trials' phase) and if the peers' disclosures convey more negative news (as measured by the firms' stock price reaction). We also find that firms are more likely to abandon ongoing trials if a larger number of peers disclose the results of closely related trials. Additional tests suggest that this real effects channel does not drive the impact on the firms' disclosure decisions.

示范问题六、宠物类型与消费者心理

周围多是狗的人与周围多是猫的人消费心理有没有不同？(Journal of Marketing, 2022)

The Pet Exposure Effect: Exploring the Differential Impact of Dogs Versus Cats on Consumer Mindsets

Lei Jia, Xiaojing Yang, Yuwei Jiang

First Published March 18, 2022 | Research Article | Check for updates
https://doi.org/10.1177/00222429221078036

Article information

Altmetric 355

Abstract

Despite the ubiquity of pets in consumers' lives, scant research has examined how exposure to them (e.g., recalling past interactions with dogs and cats, viewing ads featuring a dog or a cat) influences consumer behavior. The authors demonstrate that exposure to dogs (cats) reminds consumers of the stereotypical temperaments and behaviors of the pet species, which activates a promotion- (prevention-) focused motivational mindset among consumers. Using secondary data, Study 1 shows that people in states with a higher percentage of dog (cat) owners Google more promotion- (prevention-) focused words and report a higher COVID-19 transmission rate. Using multiple products, Studies 2 and 3 demonstrate that these regulatory mindsets, when activated by pet exposure, carry over to influence downstream consumer judgments, purchase intentions, and behaviors, even in pet-unrelated consumption contexts. Study 4 shows that pet stereotypicality moderates the proposed effect such that the relationship between pet exposure and regulatory orientations persists to the extent consumers are reminded of the stereotypical temperaments and behaviors of the pet species. Studies 5–7 examine the role of regulatory fit and evince that exposure to dogs (cats) leads to more favorable responses toward advertising messages featuring promotion- (prevention-) focused appeals.

其它问题

1. 问题：公司股权结构对股价的信息含量(Informativeness)是否有影响？（Fang et al., 2019 JIBS）
   https://link.springer.com/article/10.1057/s41267-019-00240-w
2. 问题：会计学研究中的控制变量的（过度）使用已经失控了?（Whited et al., 2021 The Accounting Review）
3. 问题：美国从中美贸易中的消费者获益有多大？（Bai and Shumptner,2019 AER）
   https://www.aeaweb.org/articles?id=10.1257%2Faeri.20180358
4. 问题：康乾盛世是因为引入了美洲作物（玉米、番薯）吗？（陈志武，2013；侯杨方，2022）
   http://www.eeo.com.cn/2013/0914/249784.shtml
   https://new.qq.com/rain/a/20220608A03UAP00

数据分析软件

常见的编程软件有：

1. STATA （社会科学领域学术研究常用）
2. SAS （工业界常用）
3. R （统计与数据科学领域常用）
4. Python （工业界与数据科学领域常用）

任何可编程软件均可作为数据构造的工具。这些软件之间并无实质性差异。在课程中我们将使用STATA 作为演示软件。大家可选任何一个数据分析软件完成本课程的相关作业与Project。

关于数据分析软件这部分内容，请同学们自学。以下网站可供学习参考：
https://lost-stats.github.io/

数据的可靠性

数据如同矿石，有贫矿，也有富矿，还有渣矿。而且，并不是数据量越大，价值就越高。从数据挖掘出的价值的大小，取决于两个因素：（1）数据自身包含的价值大小；（2）挖掘方式（理论工具与操作工具）的合适性。

We Do Not Know the Population of Every Country in the World for the Past Two Thousand Years

Published online by Cambridge University Press: **31 August 2023**

Timothy W. Guinnane

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Abstract

Economists have reported results based on populations for every country in the world for the past two thousand years. The source, McEvedy and Jones' *Atlas of World Population History*, includes many estimates that are little more than guesses and that do not reflect research since 1978. McEvedy and Jones often infer population sizes from their view of a particular economy, making their estimates poor proxies for economic growth. Their rounding means their measurement error is not "classical." Some economists augment that error by disaggregating regions in unfounded ways. Econometric results that rest on McEvedy and Jones are unreliable.

"... we haven't just pulled the figures out of the sky. Well, not often."

—McEvedy and Jones (1978, p. 11)

变量之间关系的层次

所有变量之间的关系大致可分为三种形式

1. 精确函数关系：$y = f(x)$
   - 质能方程：$E = mC^2$
   - 自由落体: $h = \frac{1}{2}gt^2$
2. 因果关系
   - $x =$施肥量，$y =$作物收成
   - $x =$每天体育锻炼的时间，$y =$身体健康状况
3. 相关关系
   - 绝大部分变量之间的关系
   - $x =$游泳溺亡的人数，$y =$冰淇淋的销售量
   - $x =$个股价格，$y =$大盘指数

函数关系 vs 因果关系 vs 相关关系

函数关系代表了永恒性，因果关系代表了必然性，而相关关系代表的是或然性。

对研究者来说，精确函数关系可遇而不可求；相关关系基本无需论证。就科学研究而言，人们探索的是必然性。所以学术界更关注因果关系。

但这并不表示研究相关关系没有价值。一方面，不能严格论证因果关系并不表示因果关系不存在；另一方面，就社会实践而言，尤其在数据足够丰富的情况下，有时候，相关关系可能足够解决很多关键问题。

社会科学中因果探索的四种模式

Morgan and Winship (2014) "Counterfactuals and Causal Inference: Methods and Principles for Social Research": Four modes of causal inquiry in social science

- *Mode 1. Associational Analysis*. In practice, most causal inquiry begins with an assessment, sometimes unreported, of whether a putative causal variable and outcome variable are associated in some way. – 相关性分析
- *Mode 2: Conditional Associational Analysis*. After an association has been established, it is customary to then reestimate the association after conditioning on values of other observed variables. – 回归与机器学习

社会科学中因果探索的四种模式

- *Mode 3: Mechanism-Based Analysis*. Perhaps after obvious forms of spuriousness have been eliminated through conditioning, a common practice in causal inquiry is to then introduce intervening variables between the putative causal variable and the outcome variable in an effort to provide a mechanistic explanation of the process that generates the causal effect. – 因果推断与局部均衡分析
- *Mode 4: All-Cause Structural Analysis*. Finally, at its most ambitious level, causal inquiry is pursued as an attempt to identify all causes in a chain of causality from the putative causal variable to the outcome variable, eliminating all spurious forms of association as a by-product. This approach is best represented in the forms of structural equation modeling that prevail in economics, wherein all specifications are justified with appeals to microeconomic theory and purport to explain the entire "who, when, where, and how" of all of the causes of the outcome of interest. – 一般均衡分析

社会科学研究的核心目标:因果推断

对社会科学研究来说，其核心目标通常都是建立变量之间的因果关系。

Drawing sound causal inferences from observational data is a central goal in social science. –Statistical Models and Causal Inference, 2010 Cambridge University Press

为什么因果关系对于我们很重要？（1）有了因果关系后，我们可以对政策或者情景的改变带来的影响进行预测；（2）因果关系可以告诉我们在备选（或者是反事实）的情境下会发生什么。

如何证明变量之间存在因果关系

理论方法：建立公理体系和假设，在此基础上演绎推导出变量之间的因果联系。这种方法的问题是，理论体系推导出来的结果未必和现实世界的现象吻合。

实验方法：随机对照试验。将实验对象随机分为处理组（Treatment Group）和对照组（Control Group）。随机对照实验是被学术界公认的论证因果关系的黄金准则。这种方法的问题是，在绝大部分情况下，随机分配要么无法做到，要么成本非常高。也就是说，随机对照试验理论丰满，但是现实骨感。

由于对于绝大多数研究者来说，通过随机对照试验来证明因果关系的难度太大。研究者们通常是两种选择：（1）回避因果关系，将注意力放在相关性分析上；（2）通过可控的拟实验（quasi-experiment）–实验对象被分配的条件由研究者根据一定的可行的（而不是随机的分配）标准决定。这通常需要新的计量经济学方法来解决内生性或者是混杂性（confounding）。

因果关系与其他条件等同（Ceteris Paribus）的概念

- 一个典型的研究问题通常是考察某个具体的变量x与y之间的因果关系。
- 随机对照试验反应的是因果关系的根本界定：变量x是变量y的原因，如果在其他影响y 的因素保持不变的情况下，x的改变带来y的改变。
- 我们需要在一个有限的封闭系统内来考察因果关系，也就是说，我们关心的结果变量y的变化是由有限的一组变量所决定的。
- 我们假设$y, x, z_1, \ldots, z_k$构成了我们的封闭系统。也就是说，除了不可控的随机因素之外，y的变化完全由$x, z_1, \ldots, z_k$所决定。
- 在这种情况下，只要我们能够找出当$z_1, \ldots, z_k$不变时，x改变（一个单位）带来的y的改变量，那么这个改变量就对应着x对y的因果效应。

因果效应的识别

- 因果效应的识别涉及到两个难题。
- 第一是如何找到$z_1, \ldots, z_k$使得$y, x, z_1, \ldots, z_k$ 构成一个封闭系统；这个问题通常难度更大。
- 第二是如何确定出（基于数据准确估算出）那个当$z_1, \ldots, z_k$不变时，x改变（一个单位）带来的y 的改变量。
- 如果研究者能够控制数据的生成过程，比如进行随机试验，那么这两个难题通常都能解决。
- 但对于绝大部分的社会科学研究来说，研究者不能控制数据的形成过程。由于参与个体是人，出于人道的，公平的，或者法律的原因，我们不能进行随机对照试验。研究者所拥有的是个体自然选择形成的观测性数据(observational data)。

基于观测性数据的因果效应的识别

- 对于观测性数据，我们需要一套新的理论工具来实现因果关系的识别和量化。
- 传统的计量经济学教材关注的主要是第二个问题的解决。以往的教材以及实证研究，在涉及到因果关系的论证时，通常表述的并不够严谨。
- 本课程会结合最新的学术研究成果来相对较为系统的讨论观测性数据的因果效应识别问题。
- 当然，不能论证出因果关系并不表示因果关系不存在。很有可能因果关系确实存在，但是由于数据或者方法的原因，我们没办法在逻辑上令人信服的推断出因果关系。

实证分析的四个FAQs

Angrist and Pischke 2009（《最无害的计量经济学》）指出，任何一个实证分析的计划可以围绕以下四个 FAQs 展开：

FAQ 1 在本研究中，你关心的因果关系是什么？

FAQ 2 为了论证该因果关系，理想的实验该怎么做？

FAQ 3 如何论证你手上的数据（的生成机理）和理想的实验是近似吻合的？

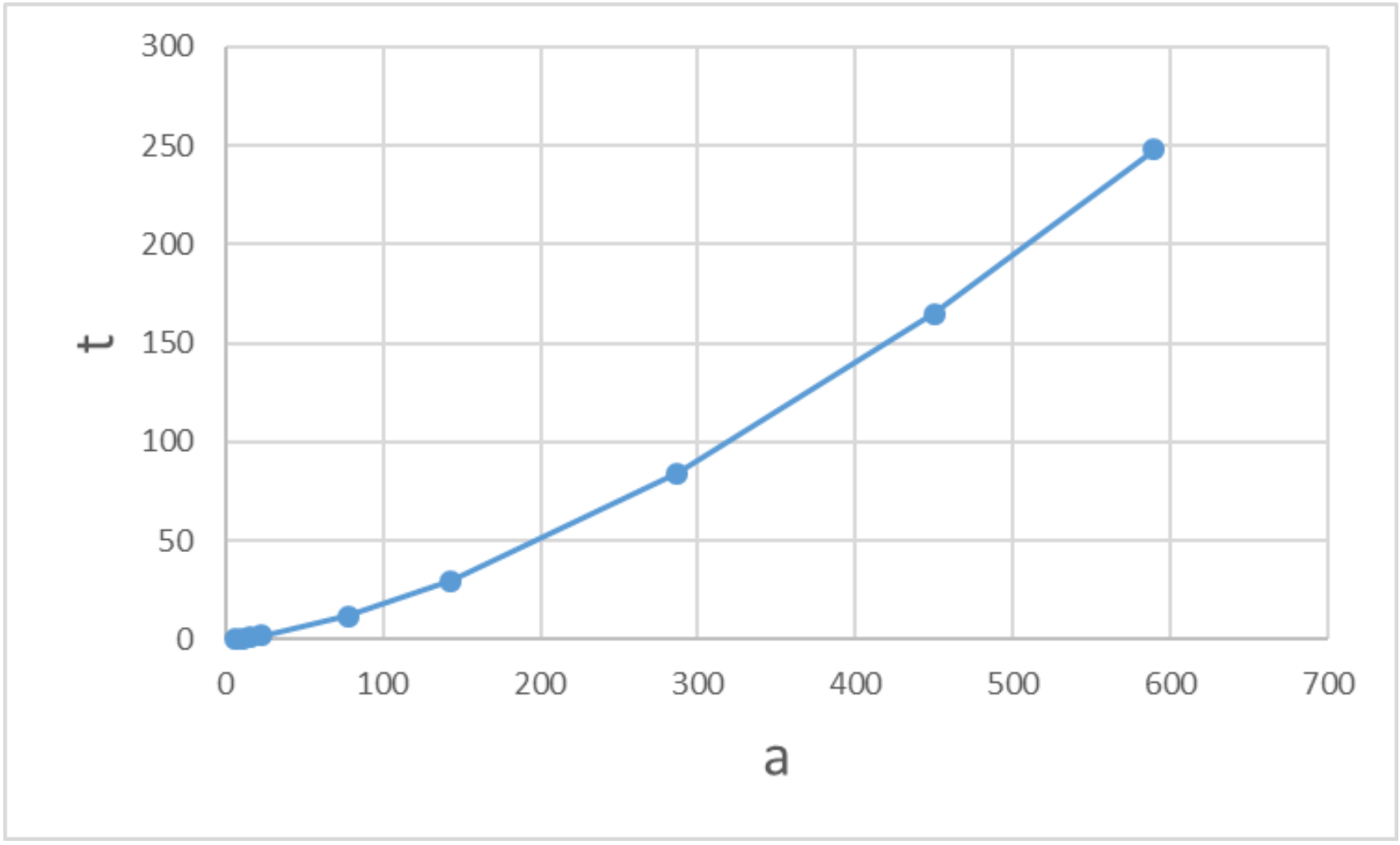
FAQ 4 如何基于数据对因果效应的大小进行估计？

FAQ 1，FAQ 2 通常比较容易回答。 FAQ 3 的答案依赖于具体的问题，这部分内容通常在具体学科的经典文献中有阐述。

本课程的前面部分主要讨论的是 FAQ 4 中涉及到的一种最主要的统计推断方法：多元线性回归模型分析方法

a	t
5.79	0.241
10.8	0.615
15	1
22.8	1.88
77.8	11.9
143	29.5
287	84
450	165
590	248

a与t有没有关系？如果有，是什么？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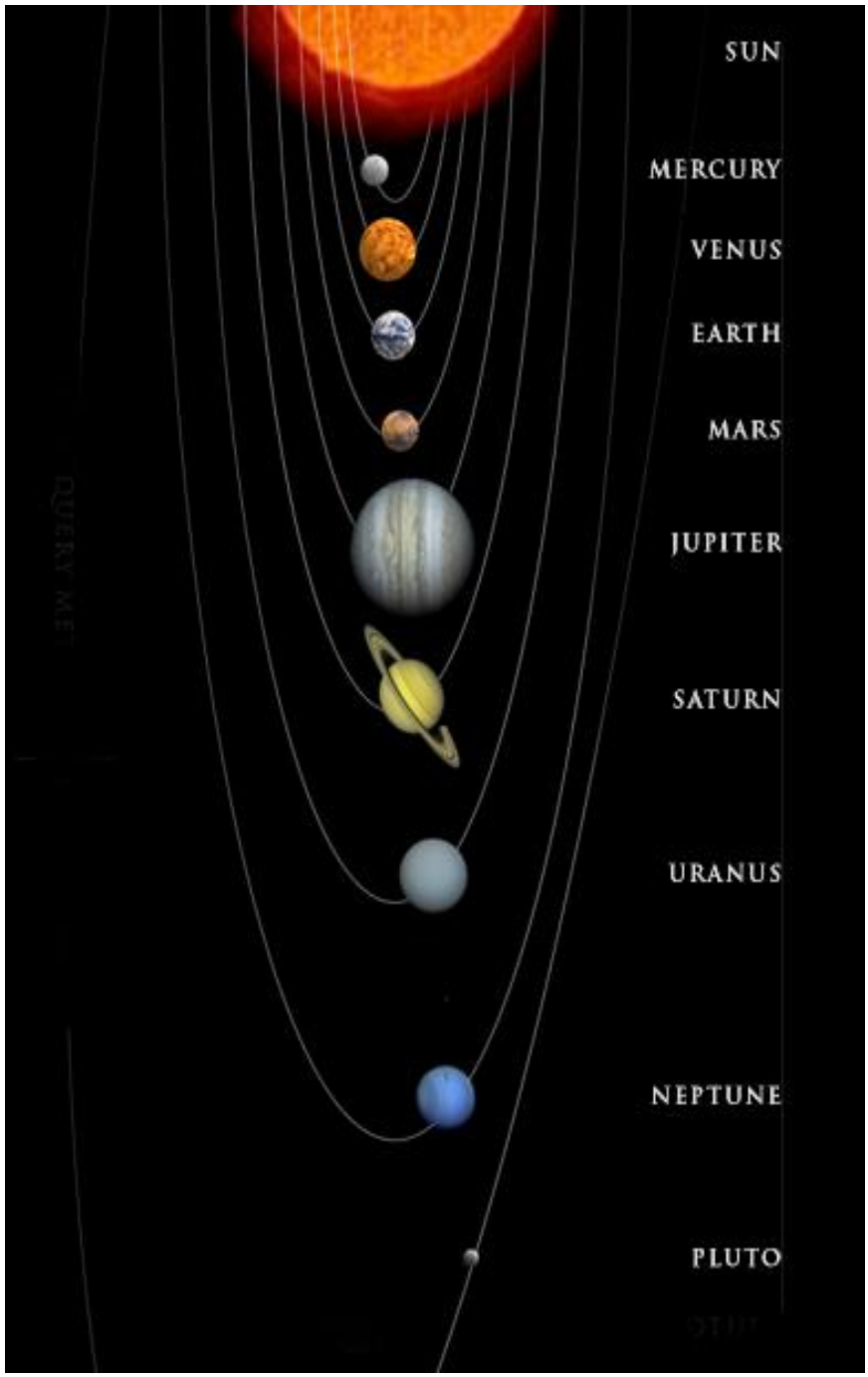
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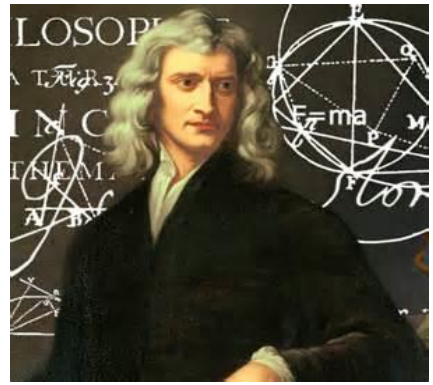
行星运动三大定律



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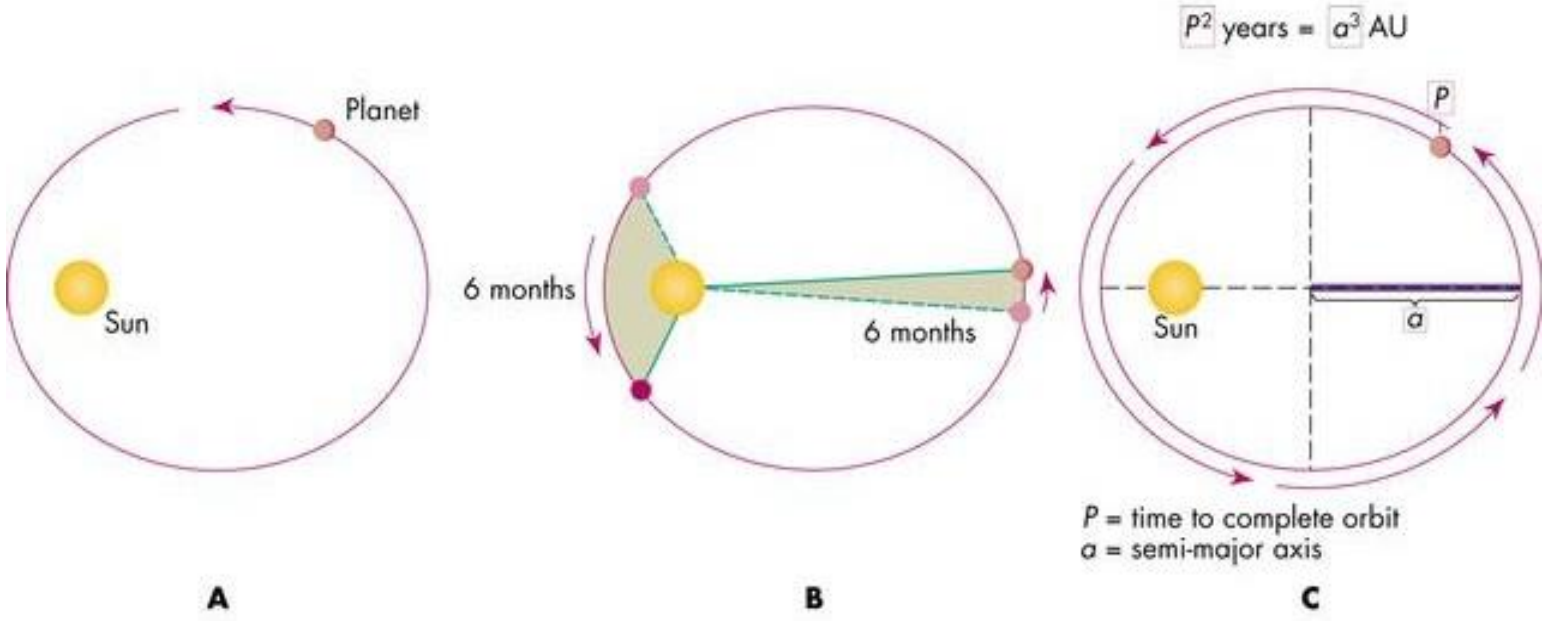
万有引力定律

开普勒行星运动三大定律



Planet	Semimajor axis (10^{10}m)	Period T (y)
Mercury	5.79	0.241
Venus	10.8	0.615
Earth	15	1
Mars	22.8	1.88
Jupiter	77.8	11.9
Saturn	143	29.5
Uranus	287	84
Neptune	450	165
Pluto	590	248

开普勒是如何发现第三定律的？

利用观测性数据进行实证分析的步骤

第一步，理论构建。也就是说，构建你的封闭系统，确定$Y, X, Z_1, \ldots, Z_k$

第二步，数据构造。通常你需要整合多个渠道的数据，并对数据进行一系列的变换，以得到实证分析可用的数据。

第三步，计量模型构建。根据可获取数据的结构特征，构造能够反映数据特征的计量经济学模型（也就是，对(Y, X, Z)的联合概率分布的某个特征进行设定），并利用数据进行参数估计和假设检验。

第四步：因果关系论证。论证前述数据分析得到的变量之间的定量关系就是它们之间的因果效应。

第五步，各种稳健性检验。尝试不同的变量定义，不同的函数关系，不同的估计方法等等，验证前述结果的稳定性。

计量模型的旗舰：线性回归

所谓计量模型，就是一个对于观测数据(Y_i, X_i, Z_i)的概率分布的某个特征的一个设定。

当我们假设$E[Y_i|X_i, Z_i]$是一个线性函数时，也就是说，

$$E[Y_i|X_i, Z_i] = \alpha + \beta X_i + Z_i'\gamma, \tag{1}$$

这样的计量模型叫做线性回归模型。

线性回归是一个极其简单的统计模型，但为什么它经常是实证分析首选的计量模型？

首先，$\beta = \frac{\partial E[Y_i|X_i,Z_i]}{\partial X_i}$。因而，$\beta$ 代表的就是一种其他变量(Z_i)不变的情况下，某一变量(X_i)变化对结果变量的平均取值的影响。从字面上来看，β 似乎代表的就是一种因果效应。

其次，事实上我们可以证明，在一定的假设条件下，β 确实等于某种形式的因果效应。

实证分析既是科学，又是艺术

- 实证计量分析是一个不断探索的过程：我们可以追求更好，但很可能无法判断是否最好
- 选择什么样的变量，建立什么样的模型更多的是靠对具体问题的深入了解和对数据的把握
- 计算机和算法无法知道数据的含义，但这些含义在我们在对模型的筛选中很可能很重要
- 解决实际问题要直观了解问题的背景，而不能只停留在数据的表层，不能只是靠键盘、鼠标和算法软件搞点回归分析和t检验之类

数据的三种常见结构

1. 截面数据Cross-Sectional Data：不同个体的数据（没有时间概念）

$$X_i,\ i = 1, \ldots, N$$

2. 时间序列数据Time Series Data：同一个体在不同时间点上的数据

$$Y_t,\ t = 1, \ldots, T$$

3. 面板数据(又称纵向数据) Panel Data (Longitudinal Data)：不同个体在不同时间点上的数据

$$Z_{it},\ i = 1, \ldots, N; t = 1, \ldots, T$$

截面数据

TABLE 1.1 A Cross-Sectional Data Set on Wages and Other Individual Characteristics

obsno	wage	educ	exper	female	married
1	3.10	11	2	1	0
2	3.24	12	22	1	1
3	3.00	11	2	0	0
4	6.00	8	44	0	1
5	5.30	12	7	0	1
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
525	11.56	16	5	0	1
526	3.50	14	5	1	0

时间序列数据

TABLE 1.3 Minimum Wage, Unemployment, and Related Data for Puerto Rico

obsno	year	avgmin	avgcov	prunemp	prgnp
1	1950	0.20	20.1	15.4	878.7
2	1951	0.21	20.7	16.0	925.0
3	1952	0.23	22.6	14.8	1015.9
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
37	1986	3.35	58.1	18.9	4281.6
38	1987	3.35	58.2	16.8	4496.7

面板数据

TABLE 1.5 A Two-Year Panel Data Set on City Crime Statistics

obsno	city	year	murders	population	unem	police
1	1	1986	5	350000	8.7	440
2	1	1990	8	359200	7.2	471
3	2	1986	2	64300	5.4	75
4	2	1990	1	65100	5.5	75
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
297	149	1986	10	260700	9.6	286
298	149	1990	6	245000	9.8	334
299	150	1986	25	543000	4.3	520
300	150	1990	32	546200	5.2	493

关于模型/理论的名人名言

1. Essentially, all models are wrong, but some are useful. –George Box
2. Never mind about assumptions. What counts is, how good are the predictions? –Milton Friedman
3. A model is an incomplete picture of reality. That is the definition of a model. But without a model you can't think logically, consistently, coherently about what's going on in the economy. So you built models to look at parts of the story... –Peter Diamond
4. When you don't have a theory, then you don't have a way to be rigorous. –Robert Shiller
5. More recently, "all models are false" seems to have become the universal hand-wave for dismissing any fact that does not conform to the model that is the current favorite. –Paul Romer
6. 没有理论，我们谁也无法弄懂我们所处的世界或做出明智的决定。–米尔斯海默《大国政治的悲剧》

萨金特对模型的解释

Thomas Sargent：有好多应用科学像工程学、物理学、经济学都是应用科学，我们会建立一些模型模拟世界的运行。我们的理论也是一样，都是由一系列的等式所构成，有一些随机组成部件。

我们的目的是希望解释我们所观察到的世界上的现象，而我们关键的工具是使用模型，然后放到电脑里模拟。把模拟后的数据拿来，利用数学方法，去微调它的参数，希望尽量接近于现实。

在这个过程中，我们扮演上帝的角色。所以写参数、模拟过程中是在假装，我们是在假装是上帝产生了这些数据。我们尽量想接近这个准确度。我们想接近或者模拟上帝的做法。

计量经济学与机器学习

计量经济学/统计学与机器学习/人工智能算法等本质上都是数据分析的方法，就其方法而言没有本质的区别。两者都是利用数据来发掘变量之间的定量关系的方法。

比如，回归分析的方法，既是计量经济学的核心方法，也是机器学习的核心算法。

计量经济学/统计学与机器学习/人工智能算法的区别主要在于数据分析的着重点不同。计量经济学/统计学更关注统计推断，也就是通过数据分析推断出变量之间的关系是否显著。而机器学习/人工智能算法的着重点是（检验样本上）预测的准确性。

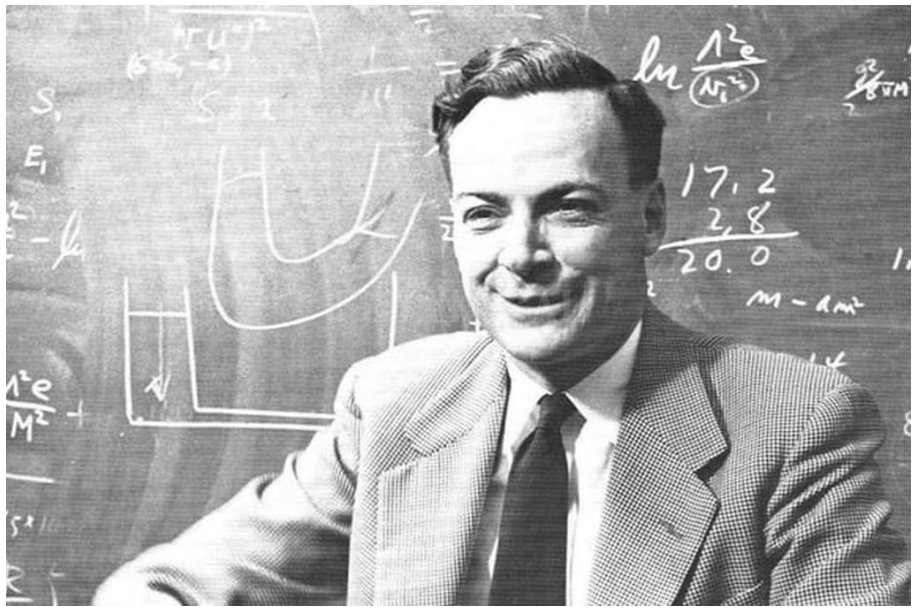
萨金特论人工智能

http://tech.qq.com/a/20180814/049868.htm

2011 年诺贝尔经济奖获奖者Thomas J. Sargent，2018年8月出席了世界科技创新论坛。在现场演讲的时候，他表示：人工智能其实就是统计学，只不过用了很华丽的辞藻。它其实就是统计学。很多公式都非常老，但是所有的人工智能都是利用统计学来解决问题的。

不论是多先进、多准确的语音识别或人脸识别技术，它的内核都离不开统计学和数学。Sargent 表示，如果你去学人工智能课程，你会发现它其实就是将不同统计方法组合起来再运行；而数学底层的最小二乘回归法，其实就是人工智能最基层的组成部分。这之间本就有着千丝万缕的关联。而人工智能和统计学，在解决问题的时候也有着相似的思维模式。

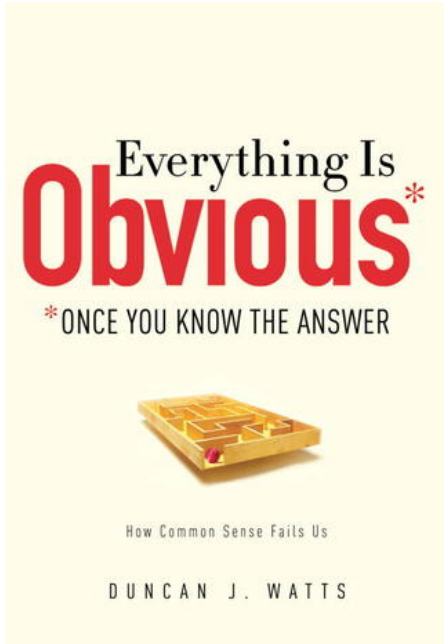
物理学家费曼眼中的社会科学



社会科学算不上科学

正因为科学取得了巨大成功，我想啊，就有了伪科学。社会科学就是这样一个例子，它算不上科学。那些人做研究并不科学，徒有形式。比如，他们收集数据，做这种那种分析，但他们得不出任何定律，没能真正发现什么。他们没有取得什么成

Everything is Obvious. Once You Know the Answer.



Since becoming a sociologist, I have frequently been asked by curious outsiders what sociology has to say about the world that an intelligent person couldn't have figured out on their own.

When every answer and its opposite appears equally obvious, then, as Lazarsfeld put it, "something is wrong with the entire argument of 'obviousness.' "