

Expanding Sustainability Economics

拓展可持续发展经济学



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UNIVERSITY OF MINNESOTA

Driven to Discover®

What is the Objective Function?

什么是目标函数?

- Productivity 生产率
- Profitability 利润
- Predictability 可预测性
- Plus 更多
 - Sustainability 可持续性
 - One health 同一个健康
 - One welfare 同一个福利
 - Compliance 合规
 - ...

The image is a composite graphic. On the left, a pig silhouette stands on a globe. In the center, there is a watermark that reads '李曼中国' (Liman China). On the right, a chalkboard displays two mathematical formulas:
$$T_H = \frac{e^\pi}{\sigma} (r)y + [\theta_f]$$
 and
$$\sum \sqrt{e^r + y^t \{h_t\}} i \frac{n}{g}$$
. Below the chalkboard, the text 'Science-driven solutions' is written in a light grey font.

What is the objective function?

什么是目标函数?

- Economics: Finding the greatest good while facing unlimited needs with limited resources
- 经济学：在有限的资源中寻找最大的利益
- Optimalities often claimed but rarely analyzed
- 经常被声称但很少被分析的最优性
- Often like partial budgets, partial optimizations are needed
- 通常需要部分优化，就像部分预算一样
 - We need to know how change affects the objective function(s)
 - 我们需要知道变更如何影响目标函数(s)

Pork production is across six economies

猪肉生产分布在六个经济体

- Pigs
- Workers
- Owners
- Processors and consumers
- Environment
- Public expectations

猪

工人

业主

处理商和消费者

环境

公众期望

水晶中国
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Optimization calculations

优化计算

- Needs: 需求:

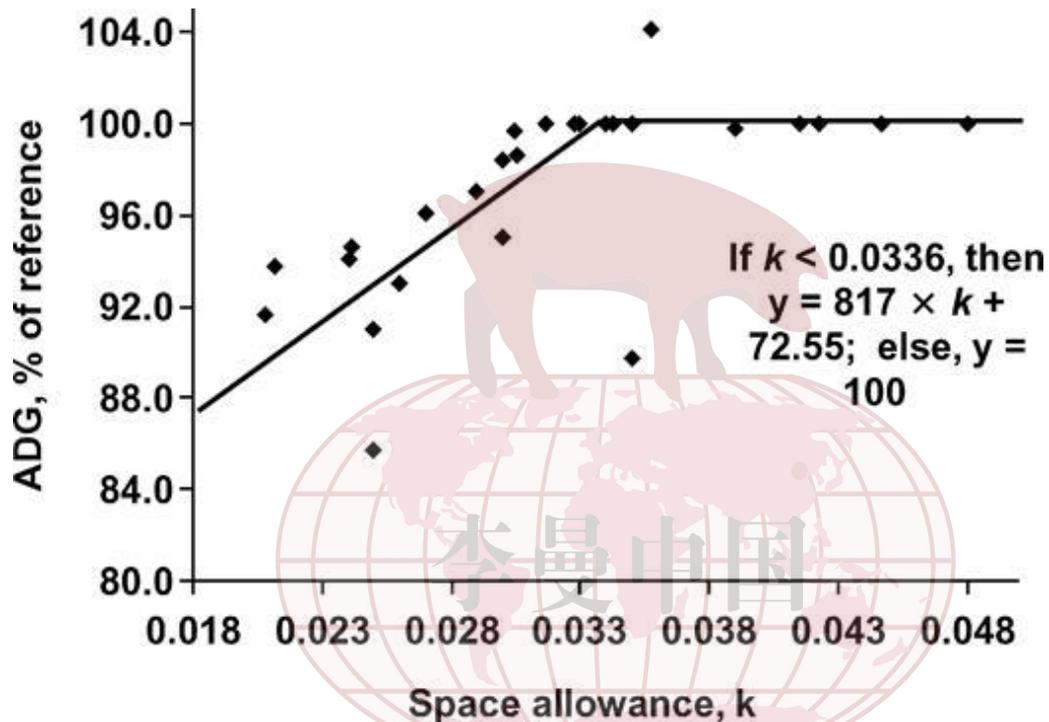
- Objective function eg sum of economies 目标函数和经济总量
- Constraints 制约因素

Problems: 问题

- Nonlinearity (the hockey stick problem) 非线性 (曲棍球杆问题)
- Lack of common units (not always money) 缺乏共同单位 (不一定是货币)
- Lack of common technical understanding 缺乏共同的技术理解

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H. W. Gonyou, M. C. Brumm, E. Bush, J. Deen, S. A. Edwards, T. Fangman, J. J. McGlone, M. Meunier-Salaun, R. B. Morrison, H. Spoolder, P. L. Sundberg, A. K. Johnson, Application of broken-line analysis to assess floor space requirements of nursery and grower-finisher pigs expressed on an allometric basis, *Journal of Animal Science*, Volume 84, Issue 1, January 2006, Pages 229–235,

H. W. Gonyou, M. C. Brumm, E. Bush, J. Deen, S. A. Edwards, T. Fangman, J. J. McGlone, M. Meunier-Salaun, R. B. Morrison, H. Spoolder, P. L. Sundberg, A. K. Johnson, 应用折线分析法评估按异速生长方式表示的育苗猪和育肥猪的地面空间需求, *动物科学杂志*, 第84卷, 第1期, 2006年1月, 第229-235页



Optimization is complicated

优化很复杂

- Win-win-win-win-win-win' s are already found
- 多赢方法的已经找到了
 - Should be celebrated 应该庆祝
- Power and knowledge is unevenly distributed
- 权力和知识的分配不均衡
- Usually a change by one area is assumed to have no effect in other areas
- 通常假设一个区域的变化对其他区域没有影响
- Often best to identify shadow values (marginal change)
- 通常最好确定阴影值 (边际变化)
- Non-linear, often driven by inflection points
- 非线性, 通常由拐点驱动
- Broad impact statements can be useful
- 广泛的影响力声明可能有用

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Types of Thinking



Optimality means each economy is understood 最优意味着每个经济体都被理解



The Observer

World Bank's funding of 'hog hotel' factory farms under fire over climate effect

Environmental and animal welfare groups call on lender to phase out support for 'industrial' livestock operations

Jon Ungoed-Thomas

Sun 7 Apr 2024 12.00 BST

- Most changes in price, markets and rules affect all parties (yet we pretend they don't)
- 大多数价格、市场和规则的变化影响到所有各方（但我们假装他们没有）
- No one has all the expertise
- 没有人具备全部专业知识
- Often devolves to virtue signaling and its opposite
- 往往会退化为美德信号及其对立面

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CALIFORNIA PROP 12

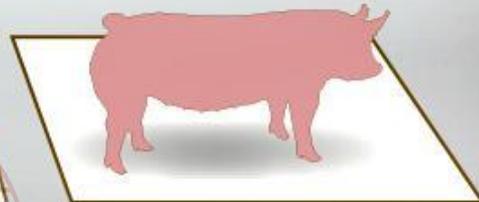
加利福尼亚州提案12



16 - 18 sq. ft.

Today's Typical Space Per Sow

16-18平方英尺
当今每头母猪的典型空间®



24 sq. ft.

Prop 12's Space Requirement

24平方英尺
提案12的空间需求

Prop 12, an American challenge:

提案12, 美国的挑战:

- Sows: more space but more mixing (fighting and lameness)
- 母猪: 空间更大, 但混合更多 (打架和跛行)
- Laborers: more demands, especially in breeding
- 劳动力: 需求增加, 特别是在育种方面
- Owners: more costs in labor, buildings and often productivity and inputs
- 业主: 劳动力、建筑成本增加, 生产效率和投入也经常增加
- Processors and consumers: limited supply and more segregation of product, increased cost of product
- 处理商和消费者: 供应有限, 产品更加隔离, 产品成本增加
- Environment: more buildings, increased input requirements
- 环境: 更多建筑物, 增加投入要求
- Public expectations: sow welfare improved, no other changes
- 公众期望: 改善母猪福利, 无其他变化



Marginal values: example lameness

边际值：跛行例子

- Sows: long-term painful condition – affects behavior
- 母猪：长期疼痛状况-影响行为
- Workers: surveys suggest major welfare observation, frustrating work
- 工人：调查显示主要的福利观察，令人沮丧的工作
- Owners: affects productivity, replacement rates, profitability
- 所有者：影响生产率、更新率和盈利能力
- Processors: Inhibits processing, raises costs
- 处理商：抑制加工，增加成本
- Earth: decreases efficiencies
- 土壤：降低效率
- Public: no knowledge (or expectations)
- 公众：无知识（或预期）

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Another question: what would each economy do with extra investment (shadow values)

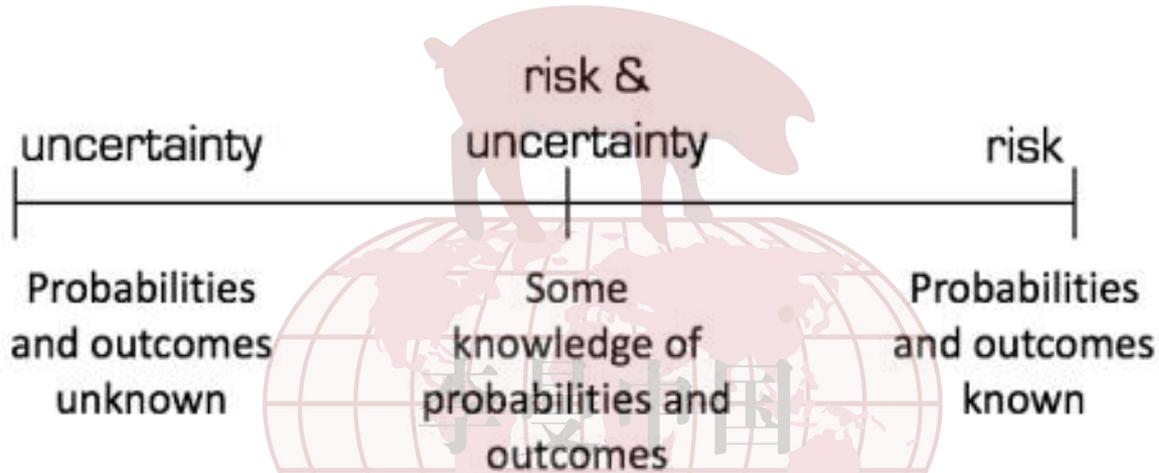
另一个问题是：每个经济体将如何处理额外投资（影子价值）

- Sows: More food 母猪：更多饲料
- Labor: Increased security 劳动力：安保加强
- Farmers: Risk management 农民：风险管理
- Processors and consumers: Acceptance 处理商和消费者：接受
- Earth: reduce wastage 土地：减少浪费
- Public: marbling 表面：大理石纹
- Are these operant behaviors 这些是操作行为吗

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Risk & Uncertainty Continuum



Source: Casavant, Kenneth, Infanger, and Bridges

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Observations 意见

- Get ready to explain your shadow values 准备好解释你的影子值了
 - Listen for the shadow values of others 倾听他人的阴影值
- Optimization is not an exact equation for this problem, but we need to know the effects of changes on each party
- 优化并不是这个问题的精确方程式，但是我们需要知道改变对各方的影响
- Ignorance is risk
- 不知情是风险

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Resources 资源

- Resource economics 资源经济学
- Optimization approaches within disciplines 学科内优化方法
- Eg welfare: 例如福利:
 - are all significant effects to be equally weighted for optimized welfare?
 - 在优化福利时, 这些显著影响是否都被同等重视?

Timelines for adoption and reversibility are important
采用和可逆性的时间表很重要



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