OR and Decision Aiding

Some (personal) thoughts on our field and its future

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ENTER HERE
TODAY'S SEMINAR:
THE ART OF DECISION MAKING
ENTER HERE
UH, OH...

Operational Research

- **Young discipline**
  - **ORQ, Vol. 1, n° 1, March 1950**
- **Many scientific and practical achievements… but**
- **A discipline not without problems…**
  - **Without *press***
  - **That has not worked on its *history***
  - **That has been vigorously attacked**
    - ***The future of Operational Research is past*, JORS, 1979, R. L. Ackoff: "In my opinion, OR is dead even though it has yet to be buried"**
  - **That started as being *applied* and *interdisciplinary* and evolved differently**
  - **Game Theory, Decision under uncertainty**

Some Unanswered Questions

- **What is OR?**
  - **What does it mean to be *interdisciplinary*?**
  - **What does it mean to be an *applied science*?**
  - **Does this call for a specific epistemology?**
- **How to teach OR and train OR analysts?**
  - **What should be the standard curriculum in OR?**
- **Should we remain isolated or try to ally with some sister disciplines (Computer Science, Statistics, Management, etc.)?**
  - **ROADEF: around 200 members**
- **Should OR societies try to organize the profession?**
  - **“Labeled” OR consultants?**

Outline

- A view on OR
- OR in history
- What to do?

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OR main model

- **Build and solve models of the type**

$$\begin{aligned} &\text{Maximize } f(a) \\ &\text{s.t.} \\ &a \in A \end{aligned}$$

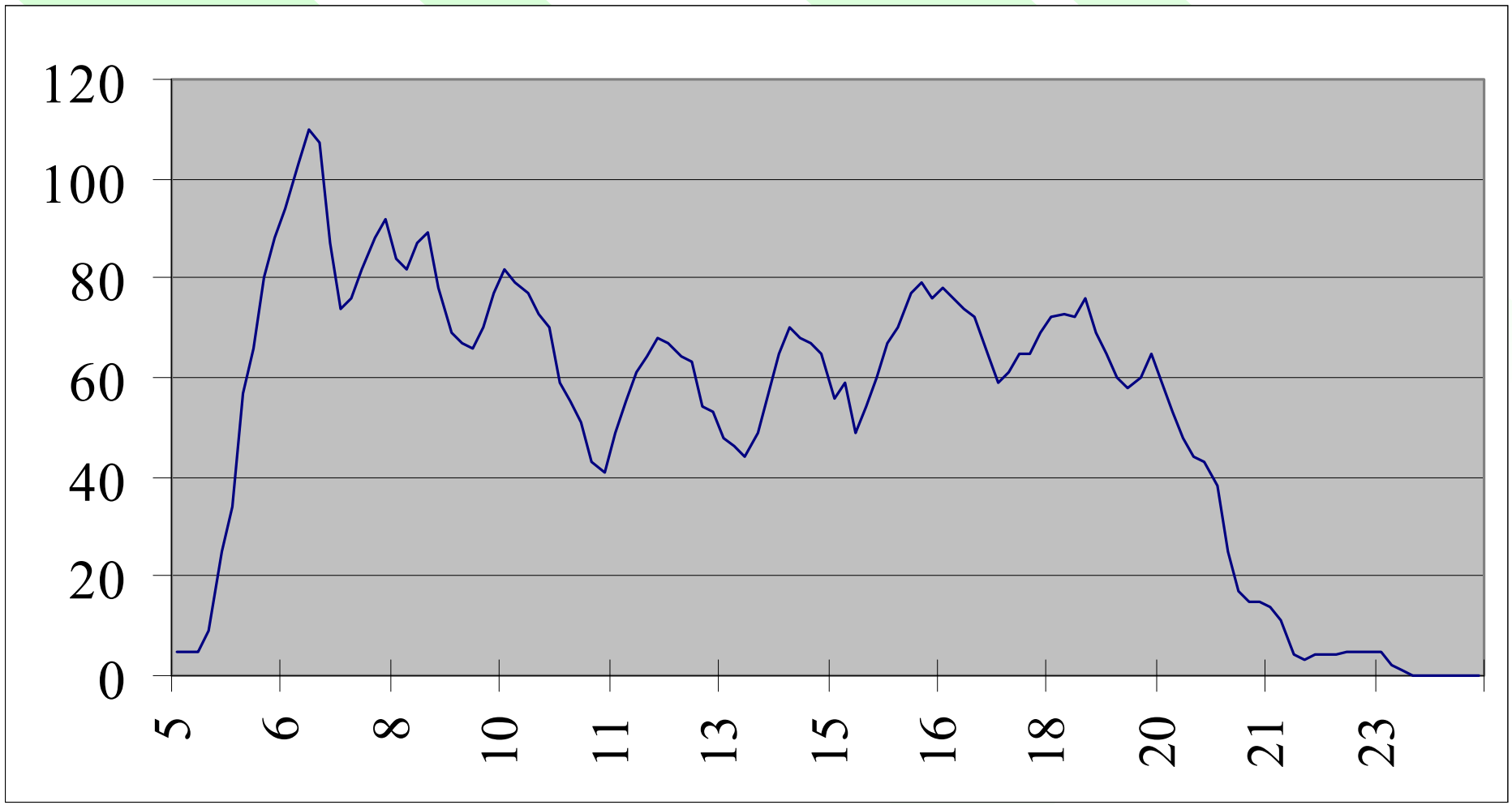
- **Solving:**
  - **Finding an optimal solution**
  - **Finding all optimal solutions**
  - **Finding solutions "close" to the optimal solutions**
  - **Finding robust solutions**
- **How are such models built?**
- **What is their relation to real decision processes?**

Example

- **Workforce Scheduling at *Aéroport de Paris***
  - **High cost of labor**
  - **Strong unions**
  - **Many legal and technical regulations**
  - **Demand highly variable throughout time**
  - **Highly competitive industry**
- **One category of persons**
  - **“bagagistes”**

    persons taking care of luggage from planes to customers

Demand Curve (normal weekday)



Classic problem

- **Cover demand with a minimum of operators**

Parameters

$t = 1, 2, \ldots, T$ periods

$C_t =$ demand in period t

$h = 1, 2, \ldots, H$ possible shifts

$$a_{ht} = \begin{cases} 1 & \text{if shift } h \text{ covers period } t \\ 0 & \text{otherwise} \end{cases}$$

Decision variables

$x_h =$ number of persons hired according to shift h

Solve the problem

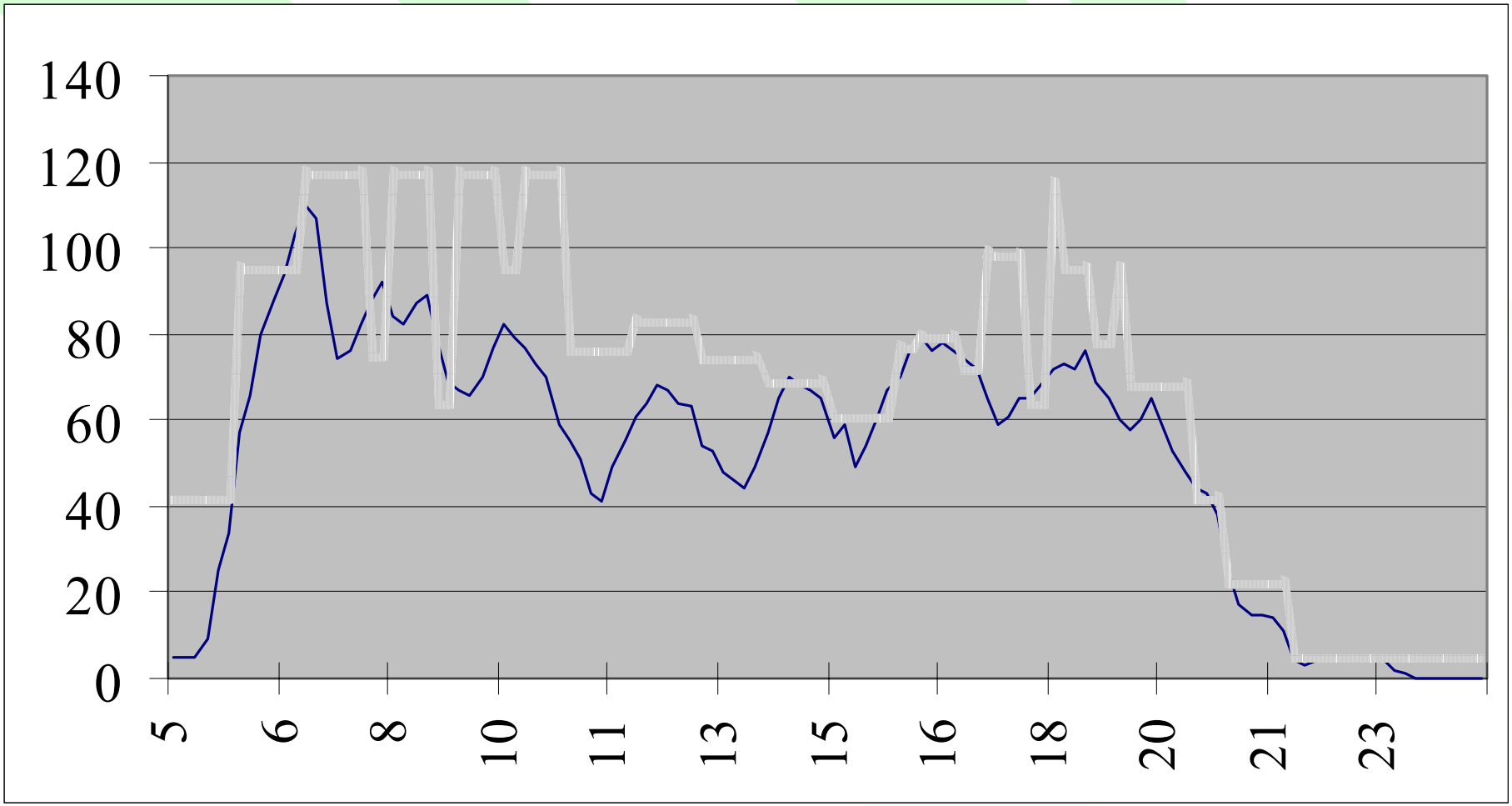
$$\text{minimize} \sum_{h=1}^{H} x_h$$

$$\text{st}$$

$$\sum_{h=1}^{H} a_{ht} x_h \geq C_t \quad t = 1, 2, \ldots, T$$

$$x_h \geq 0 \ (\in \mathbb{N}) \quad h = 1, 2, \ldots, H$$

An optimal solution



"Data"

- **Definition of candidates shifts**
  - **Implicit Constraints**
    - **Legal / Union agreements / Habits / Convenience**
    - **Hard / Soft constraints**
  - **Dealing with perturbations**
    - **Illness / Late / Strikes / Overload**
  - **In practice?**
    - **Who decides? When?**
    - **Affectation of shifts to persons (auctions, seniority, etc.)?**
  - **Days / Weeks / Months**
    - **One model or several models?**
    - **Combination?**

"Data"

- **Demand curve**
  - **How is it built?**
    - **Implicit Rules**
      - ⇨ **type of plane × destination × time of the day**
    - **Implicit Standards**
      - ⇨ **Quality?**
      - ⇨ **What is an acceptable waiting time?**
  - **Coping with uncertainty**
    - **Late planes**
    - **Changes of planes**

What is the “problem”

- Why is it raised now?
  - Malfunctioning
  - Opportunity
- What objective(s)?
  - Increased productivity?
    - How to share the gains?
  - Negotiations?
    - Possible Shifts
    - Timetable of fights
- Implementation
  - Who handle the problem?
  - How is it handled?
- Who will use the model?
  - How often?
  - To do what?

Use of optimization model

- **Optimal solution is not necessarily central**
  - **Many unforeseen constraints**
  - **Many constraints difficult to model**
  - **High uncertainty / Many implicit aspects**
  - **Multiple heuristic adjustments of the solution**
- **Model as an exploration tool**
  - **current practices / frontiers of system / objectives**
- **Indirect use of model**
  - **Possible, frequent and legitimate**
  - **Model as a tool to understand and/or dialogue**
- **Necessary contextualization of solutions *outside* the model**

In summary

- **OR analysts have a very *naive* strategy of intervention**
- **OR has no specific *doctrine* of implementation**

Strategy of the OR analyst

- **Faced with the complexity of real decision processes and organizations, the answer of the OR analysts is essentially *pragmatic* et *non-formalized***
  - **Workforce scheduling (what to formalize and what to leave outside the model?)**
- **Two "heroic" hypotheses**
  - **It is possible to have a positive role in organizations using a decision model that is essentially *individual* (optimization)**
  - **Use "common sense" and "know how" to deal with implementation issues**

Doctrine (lack of)

- **OR is an applied science…**
- **But OR analysts have not elaborated a doctrine of intervention let alone an autonomous discourse on organizations**
  - **How to justify the naive strategy?**
  - **How did we react to the transformation of organizations?**
  - **What have we learnt on organizations?**
  - **How to train OR analysts**
- **Supply chain, IS, Marketing, Strategic Management**

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OR is not an isolated case

- **Aim of OR**
  - **put reason and efficiency in the conduct of human affairs**

- **Scientific Management (1910)**
- **OR (1950)**
- **Strategic Management (1960)**
- **Expert Systems (1970)**
- **MRP (1980)**
- **Supply chain Management (1990)**
- **Knowledge Management (2000)**

Models as "*rational myths*"

- **Unavoidable conflict between the logic of the *model* and the logic of the *organization***
- **The model is a *porte d'entrée* in the organization and a lever for change**
  - **OR models are good for doing so because they are *rational myths***
    - ***Myth*: "Symbolic fable that is both simple and striking"**
    - ***Rational*: "Performance" + high internal consistency**
- **Models used unfreeze and recompose organizational structures**
  - **Learning / Contextualization / Implementation**

Hatchuel & Molet, 1986, EJOR

What does this view bring to OR?

- **Historical perspective**
  - **Successes and failures of other rational myths**
- **Doctrine: modeling and intervention**
  - **Modeling process**
    - **Learning**
    - **Constructivism**
  - **Implementation**
    - **Not always required**
    - **Beware of "*compulsive implementation*"**

Anatomy of a "rational myth"

- **Rationalization project: 3 main components**
  - **Formal structure**
    - **What is the underlying logic?**
  - **Management perspective**
    - **What aspects of organizations are concerned?**
  - **Simplified view of organizations**
    - **What is the implicit view of organizations?**
- **OR**
  - **Formal structure**
    - **Pure *decision theory***
  - **Management perspective**
    - **Rationalize *decisions***
  - **Organization**
    - **Organizations as collections of *decision makers***

Management perspectives: Evolution of rational myths

Work	:	Taylor
Decisions	:	OR
Costs	:	Audit
Markets	:	Strategic Management
Data	:	EIS / Data Mining
Flows	:	Supply chain
Quality	:	TQM
Products	:	ECR
Knowledge	:	AI / KM
??	:	??

OR in context

- **OR is part of a long history of "rationalization projects" in organizations**
  - **Competition between "rationalization projects"**
  - **We may and should learn from other fields**
  - **They should be able to learn from our field**

- **What to do?**

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Short term

- **Pay attention to competing "rational myths"**
  - **IS, Supply chain, TQM, AI, ECR, Data Mining, etc.**
    - **INFORMS vs. EURO**
    - **ERP and OR**
  - **Work on history of OR**
- **Pay attention to the evolution of organizations**
  - **Doctrine on organizations**
  - **1st step: Who asks for OR?**
    - **Legal evolutions (deregulation / privatization)**
    - **Technical evolutions (transports / NICT)**
- **Classic techniques/models do not define OR**
  - **The nature of the *rationalization project* should govern the choice of techniques**

Short term

- **Be proactive: "We know how to handle that"**
  - **Prevention of industrial risks**
  - **Evaluation of public policies**
  - **Electoral reforms**
  - **Security**
  - **Social Security reforms**
  - **Globalization**
  - **Climate change**
  - **etc.**
- **Or do we want to leave that to others? (economists, political scientists, sociologists, etc.)**
  - **Are they really better equipped than we are?**

OR's competitive advantages

- **OR survived fashion effects**
  - **50 years of experience**
- **OR remains close to production processes**
- **Scientific developments**
  - **Global Optimization, Heuristics, Complexity, Polyhedral analysis, etc.**
- **Prestigious journals**
  - **Management Science, Operations Research**

Long Term

- Formal structure: Pure decision theory
- Management perspective: Rationalizing decisions
- Organizations: Collections of Decision Makers

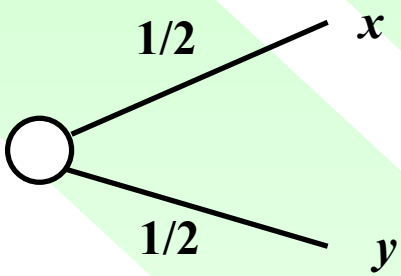
- Theoretical challenge
  - What is the present state of decision theory?
- Practical challenge
  - Is decision the right concept?

Pure decision theory

- The very idea of a “rational behavior” undergoes a major crisis in decision theory
- Going from individual to collective model is a formidable challenge

Independence axiom

If



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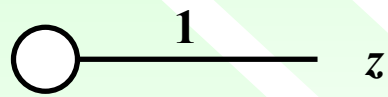
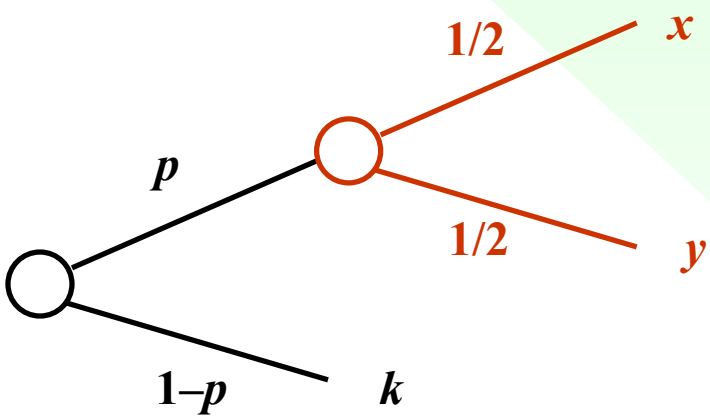


then (for $p > 0$)



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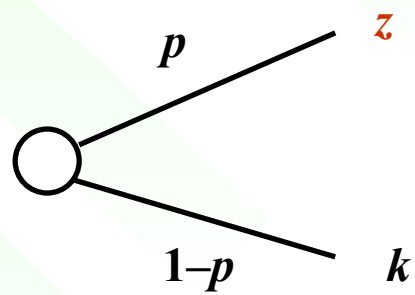
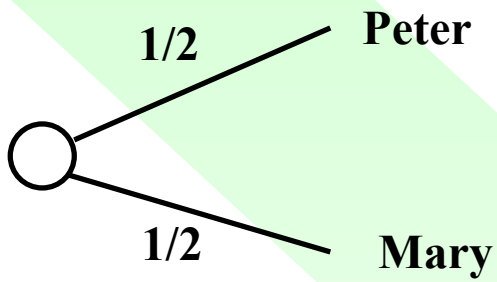


Independence axiom: Mom's choice



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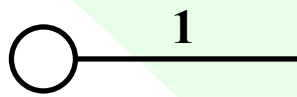

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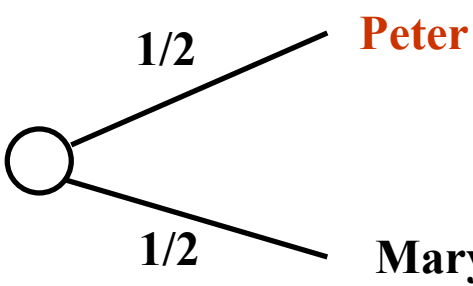

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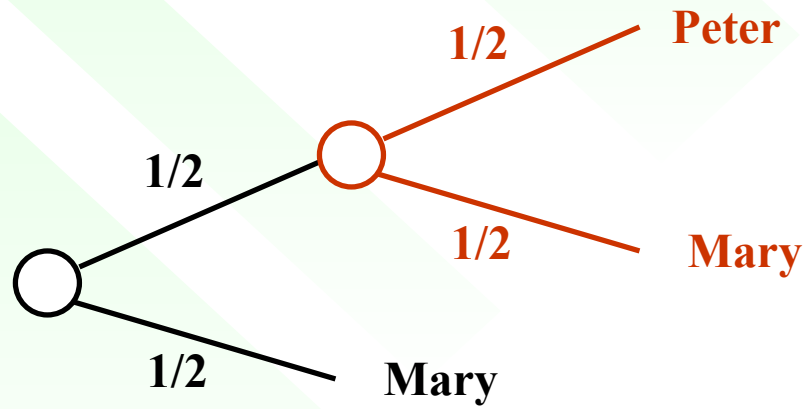
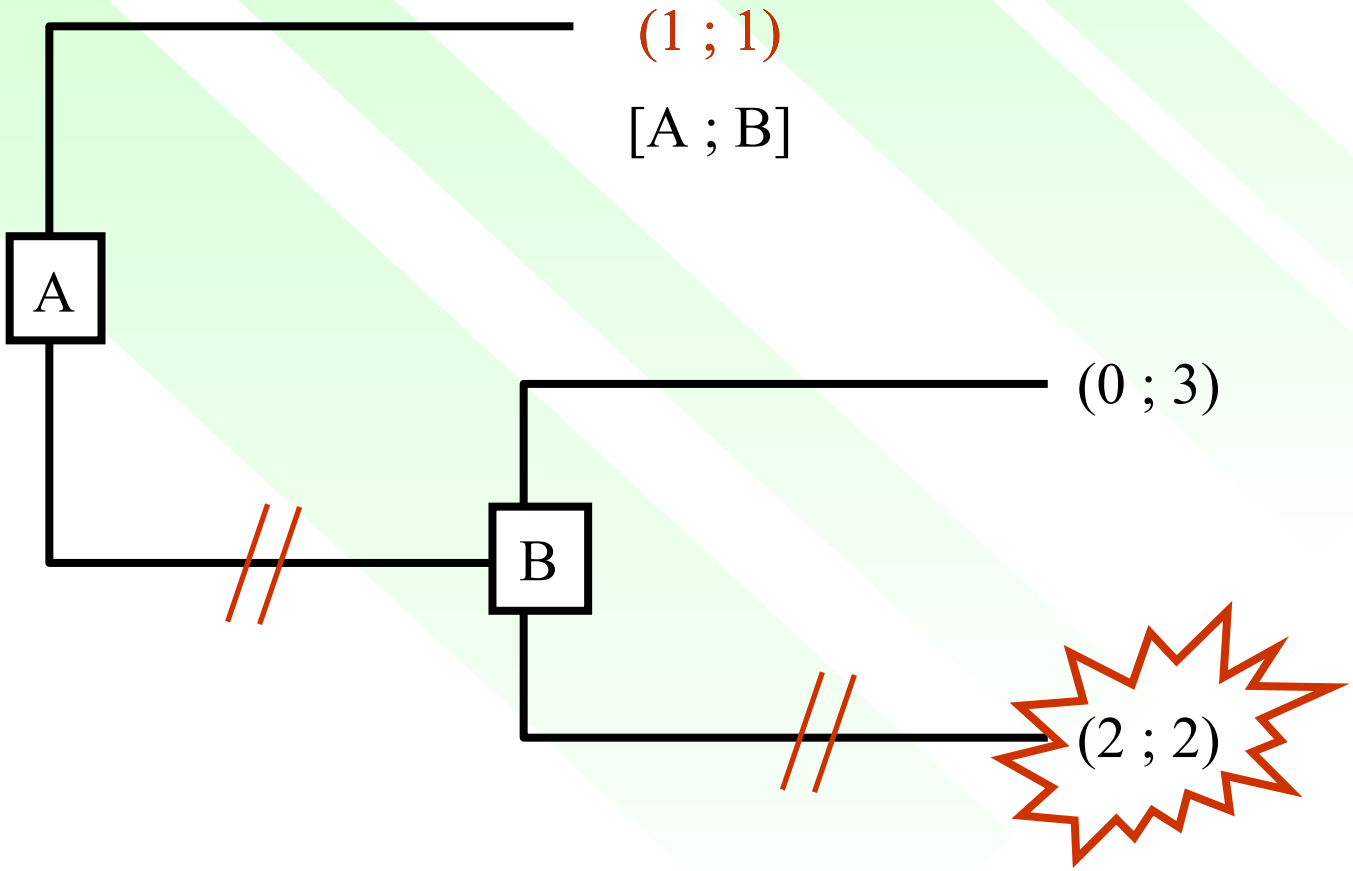


Games with perfect and complete information

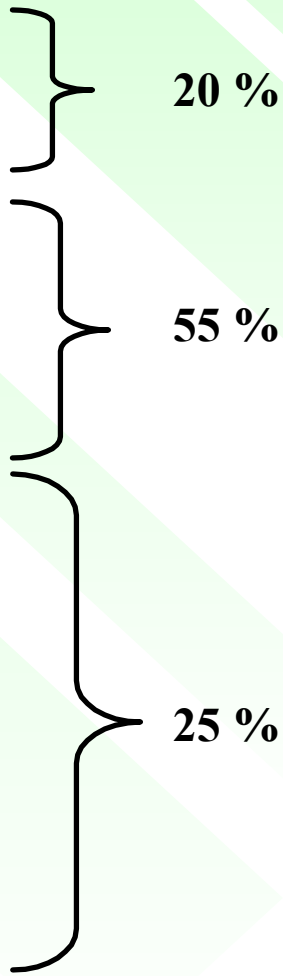


Rationalizing *decisions*?

- There are other possible and interesting management perspectives
- The bulk of management literature is *not* about decisions
- It is not at all obvious that “decisions” are central any more in organizations

How CEO spend their time?

- 15 % transports
- 5 % visits
- 5 % individual meetings
- 30 % internal collective meetings
- 10 % external collective meetings
- 10 % meals
- 15 % telephone
- 5 % mail
- 2 % writing
- 2 % reading
- 1 % thinking alone (6 min /day)
- 0 % computer usage



Rationalizing collective action

- **Deciding**
- **Structuring**
- **Planning**
- **Coordinating**
- **Controlling**
- **Inventing incentives**
- **Contracting**
- **Managing risks**

Possible (necessary?) widening of OR's rational myth

- What decision should I take?
- How to
  - Be organized
  - Coordinate with others
  - Plan while remaining reactive
  - Control results
  - Manage risks
  - Remain informed

  in order to be efficient?

Possible New Key Words

- **Production**
  - **Conception / Quality / Environment**
- **Planning**
  - **Control / Incentives / Contracts**
- **Scheduling**
  - **Equity / Motivation / Robustness**
- **Markets**
  - **Competition / Pricing / Strategy**
- **Transports**
  - **Sustainable development / Spatial equity**
- **Rationalizing collective action**
  - **Politics**