Experimental economics

Lecture 3: Economic experiments in project management

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Project management

Project → endeavour constrained by a scheduled beginning and end

Temporary nature → efficient planning of time is of crucial importance

Unrealistically optimistic schedules → budget extensions and/or quality cuts

Understanding the causes of prediction biases and uncovering approaches to mitigate them → more effective allocation and utilization of company resources

Economic experiments in project management

- Our research program was called “Economic experiments in project management”
- Why using economics methodology to study a management problem? Traditional management methods do not seem to solve it.
- The future of research is interdisciplinary. There is a good chance that the answer to your question lies in a slightly different field.
- Look for methods, expertise, insights outside the box. (E.g. Behavioral economics brings on psychological insights to bear on economic phenomena)
- In one of our papers, we address a management problem with a theory from psychology while using economics methodology.

Turning experiences into research questions

- When discussing a new project proposal, an executive incidentally expressed his opinion that the project could be delivered in six months. Although I later explicitly pointed out to all my project team members that the opinion of the executive was just a wild guess and they should not take it into consideration, all of them estimated their work to be completed in six months or less, and almost all of them were late.

- In an effort to induce more accurate project schedules, I usually tried to collect as much information about the requested project deliverables as possible. Nevertheless, I realized that I will never be able to provide my planners with a project specification that would capture all the seemingly tiny, but often important and time-consuming artefacts. Could there be a better approach towards more accurate project duration estimates than creating overly detailed project specifications?

- Sometimes I hired a contractor to develop software for a custom-made machinery. These contractors rarely missed their deadlines. At first, I was impressed by the accuracy of their duration estimates. Later, I realized that I could not distinguish whether their estimates were genuinely accurate, or they just proposed inflated schedules and then overspent time and money on the project. It occurred to me, that any “successful” project, meaning delivered on time and within budget, can in fact be a project with inflated schedule and cost estimates.

The three studies

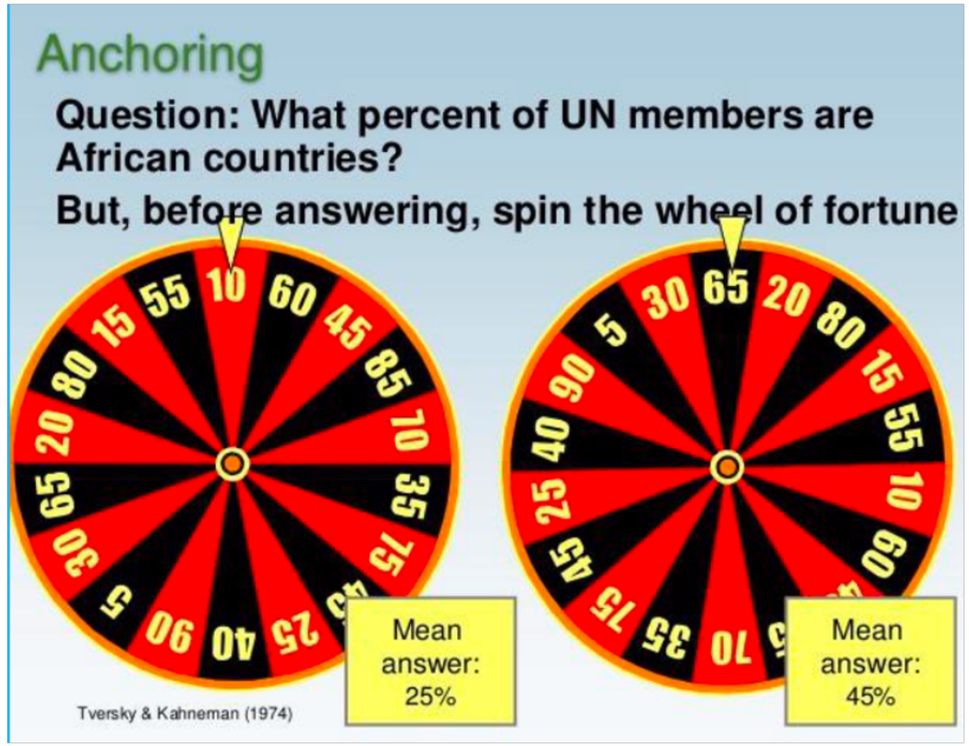
- Study 1 tests anchoring as a mechanism contributing to biased project duration estimates
  - Testing a theory
- Study 2 compares two different interventions designed to improve the accuracy of project schedules
  - Whipering to the ears of princes
- Study 3 tests the impact of incentives on estimation accuracy, but also their adverse effects
  - Searching for new facts

Why laboratory experiments?

- Using laboratory experiments, we can
  - replicate the important features of the underlying project management environment
  - implement exogenous ceteris paribus changes
  - focus only on the duration estimation
  - while ruling out the effects other project constraints and confounding factors
    - scope and the quality of requested deliverables
    - project costs, risks, unforeseen events
    - changes in executives' priorities
  - observe and control unobservables
    - repetition
    - strategic misestimation
    - beliefs

STUDY 1 - Can optimistic estimates be caused by anchors?

- Anchoring effect - Tversky & Kahneman (1974) - mistakes can be made as a result of using an initial value (an anchor) as a starting point and insufficiently adjusting the final figure away from it.
- Found in:
  - Trivia/Knowledge
  - Negotiation Probability estimates
  - Purchasing decisions
  - Self-efficacy
  - Sentencing decisions
  - Valuations
  - Effort and duration estimates

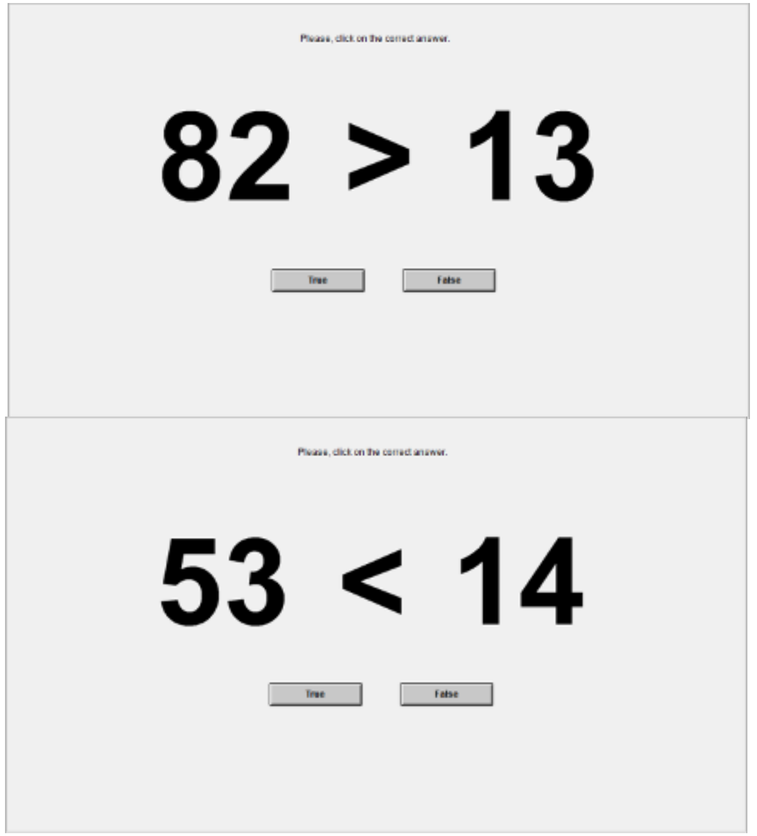


STUDY 1 - Can optimistic estimates be caused by anchors?

- Anchors in project planning:
  - Wild guess: “How long? Three months, maybe?”
  - Suggestion: “Do you think two weeks are enough for you to get it done?”
  - Customer expectations: “We would like to introduce the product to the market before summer season.”
  - Tentative deadline: “The management expressed the intention to finish the project by the end of year.”
- Research questions
  - Anchoring effect in estimating task duration?
  - Does the anchoring effect persist over time in the absence of feedback?

Experimental design

- Three rounds of same experimental task
- (Anchor) - Estimate 1 – Task 1 – Estimate 2 – Task 2 – Estimate 3 – Task 3 – Retrospective estimate
- No feedback between rounds
- Incentives for estimation accuracy and performance
- No measuring of time
- Task: 400 inequalities:
- Treatments:
  - Control => Low anchor (180 seconds), High anchor (1200 seconds)
  - *Will it take you less or more than [anchor value] minutes to complete the task?*



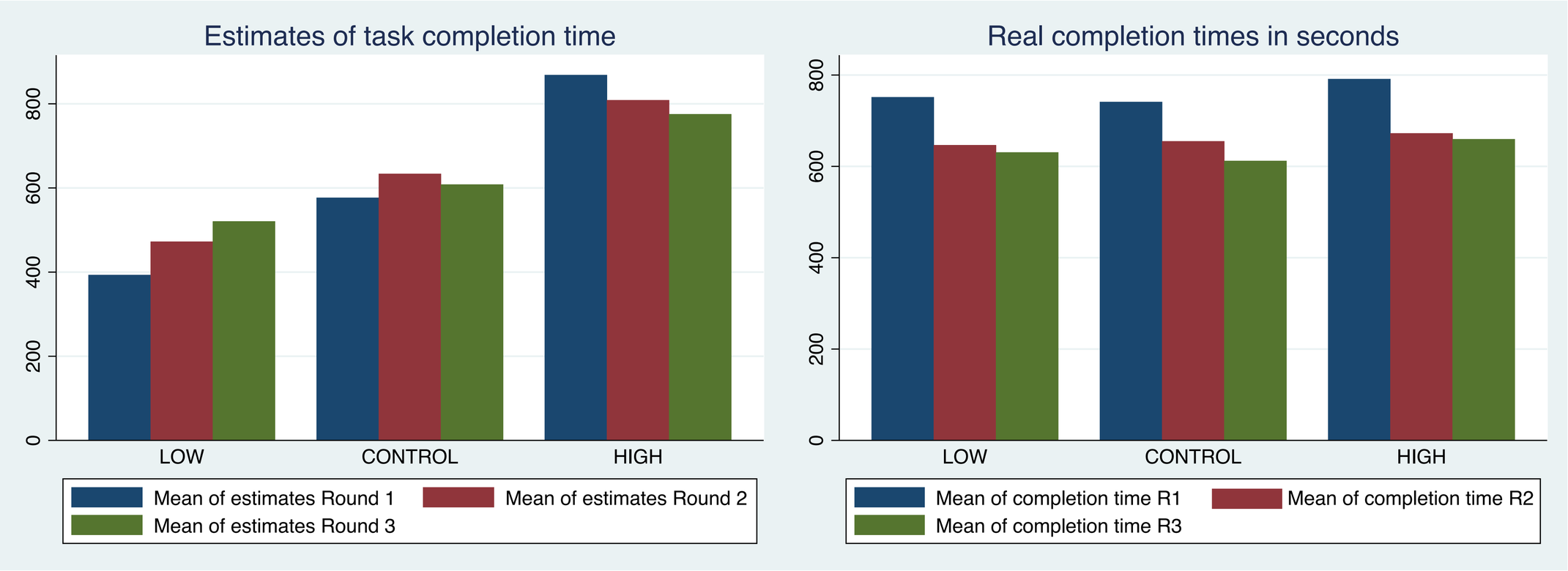
Putting the anchoring effect to test in a laboratory

- Novelty:
  - Application of anchoring to estimating task duration
  - “Long term” effects of anchoring (persistency)
  - Net anchoring effects (inclusion of Baseline)
- Favorable conditions to mitigate the anchoring effect:
  - Familiar task, clear scope, no ambiguity, no unexpected events
  - Skilled and experienced subjects
  - Appropriate incentives
  - Repeated estimation
  - Also retrospective estimation
- All in all:
  - Conservative test of the anchoring effect
  - Designed to detect the lower bound of the influence of anchors on duration estimates
  - Test the persistence of the anchoring effect

Conjectures

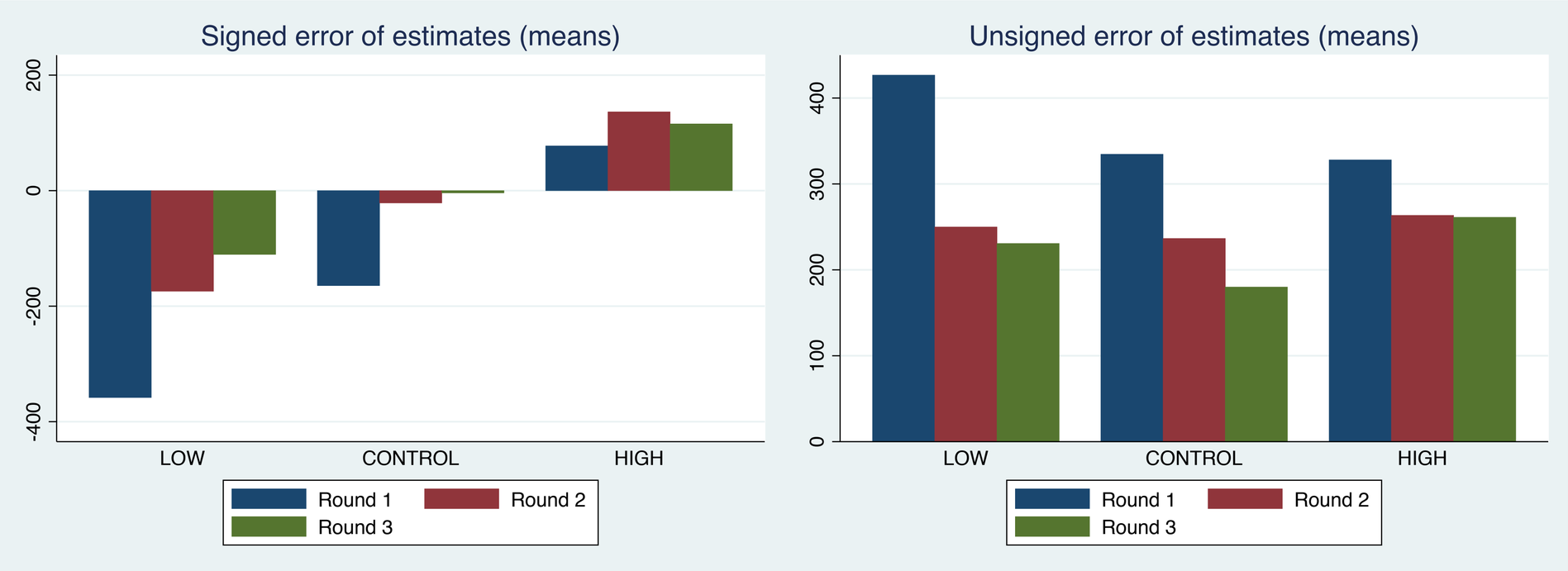
- 1. The task duration estimates will be influenced by numerical anchors.
- 2. The anchoring effect will persist over time.
- 3. Anchors will not have effect on task completion times.
- 4. Anchors will cause under/overestimation of task duration

Results – Estimates and actual task duration



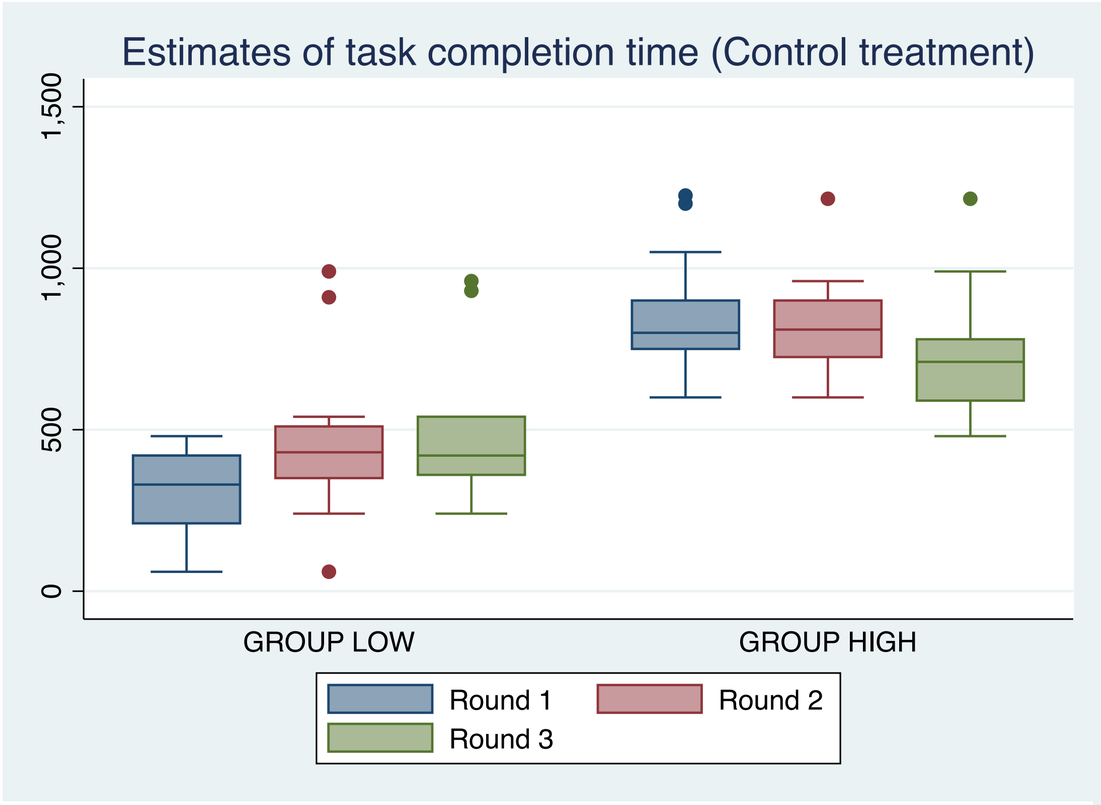
- Significant anchoring effect
- Anchoring persists over time
- No effect of anchors on completion times

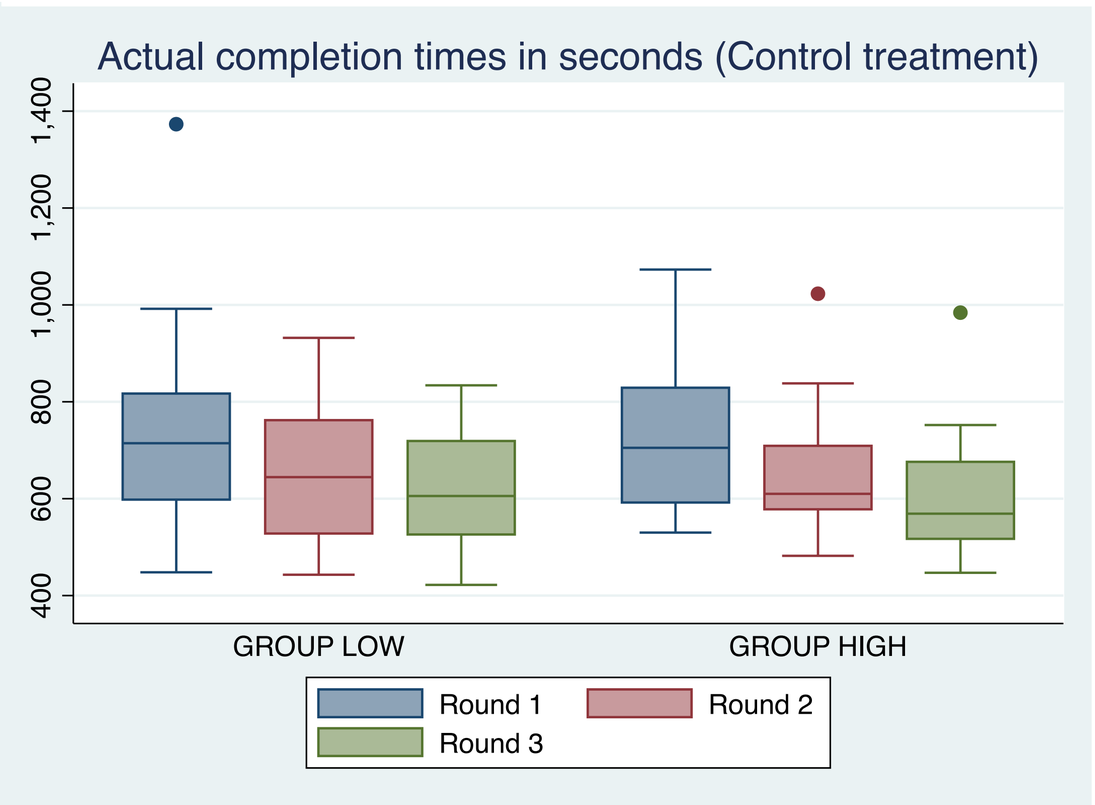
Results – Bias and (in)accuracy



- Underestimation in Low Anchor treatment (avg. of estimate - completion time)
- Overestimation in High Anchor treatment
- Unbiased Control treatment, with possible optimism bias in Round #1
- Bias causes inaccuracy in Low & High Anchor treatments
- Estimates in unbiased Control treatment also quite inaccurate (bias-variance tradeoff)

Results – Self-anchoring in Control treatment





- Significant differences in estimates, no differences in completion times
- Demonstration of self-anchoring effect

Observation – Own estimates vs. (historical) averages

Success of two types of predictions				
Treatments	Round 2		Round 3	
	Historical average	Own estimate	Historical average	Own estimate
Low	65%	35%	71%	29%
Control	67%	33%	67%	33%
High	69%	31%	77%	23%
Total	67%	33%	72%	28%

	Estimate 2 – Mean unsigned error		Estimate 3 – Mean unsigned error	
Treatment	Historical average	Own estimate	Historical average	Own estimate
Low	182	250	132	231
Control	154	237	117	180
High	151	263	132	261
Total	162	251	128	227

- Which one closer to the actual duration?
- Historical average significantly outperforms own predictions

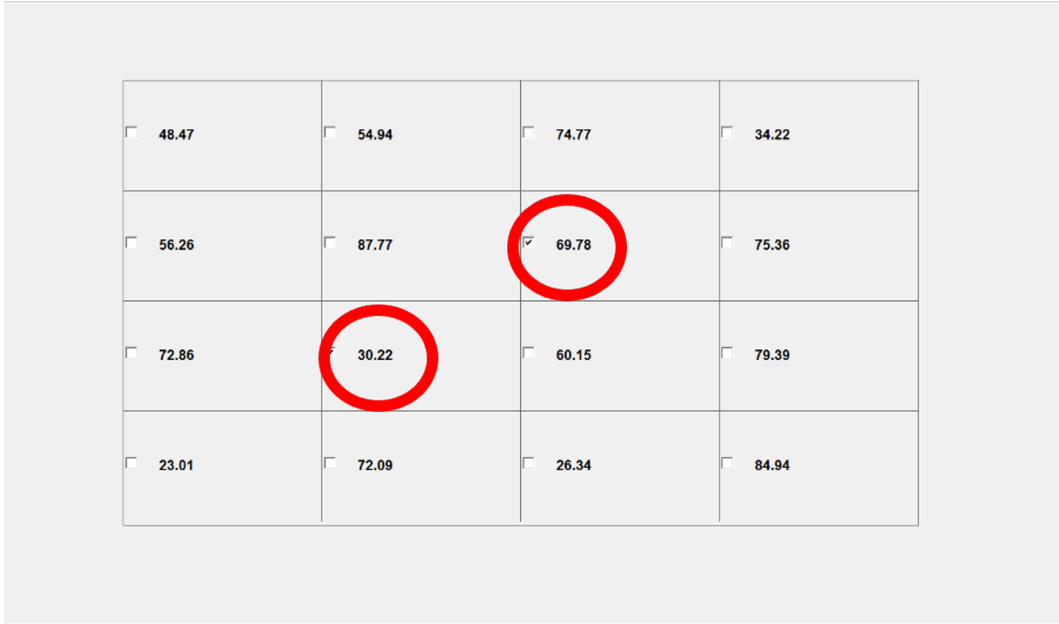
STUDY 2 - Improving the accuracy of project schedules

- The problem
  - even the most experienced planners cannot foresee all possible risks
  - even the most extensive specifications cannot capture every detail of the proposed project
  - project planners focus on the provided information, often neglecting that it might be incomplete
  - as a result, project duration estimates may become understated

- Research questions
  - Does the introduction of historical information improve the accuracy of task duration estimates?
  - Does the timing of information provision matter?
  - Can the accuracy be achieved also by more detailed project specification?
  - Does the amount of information at hand reflect on subjective confidence with the estimates?

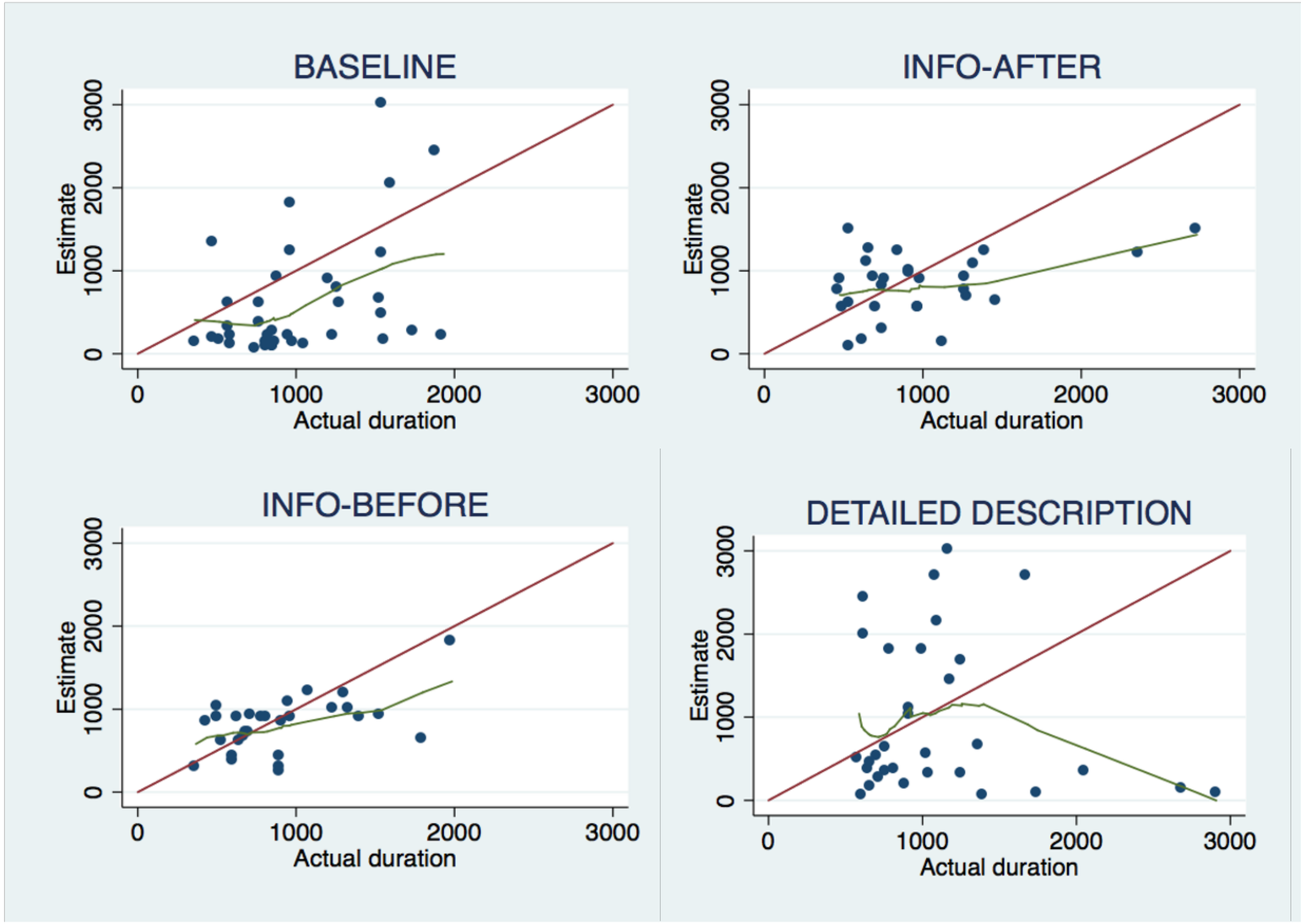
Experimental design

- 4 treatments
  - Baseline: Instructions – Estimate – Confidence – Execution
  - Info-Before: Instructions – Historical information – Estimate – Confidence – Execution
  - Info-After: Instructions – Estimate – Confidence – Hist. info – Estimate 2 – Confidence 2 – Execution
  - Detailed Description: Detailed Instructions – Estimate – Confidence – Execution



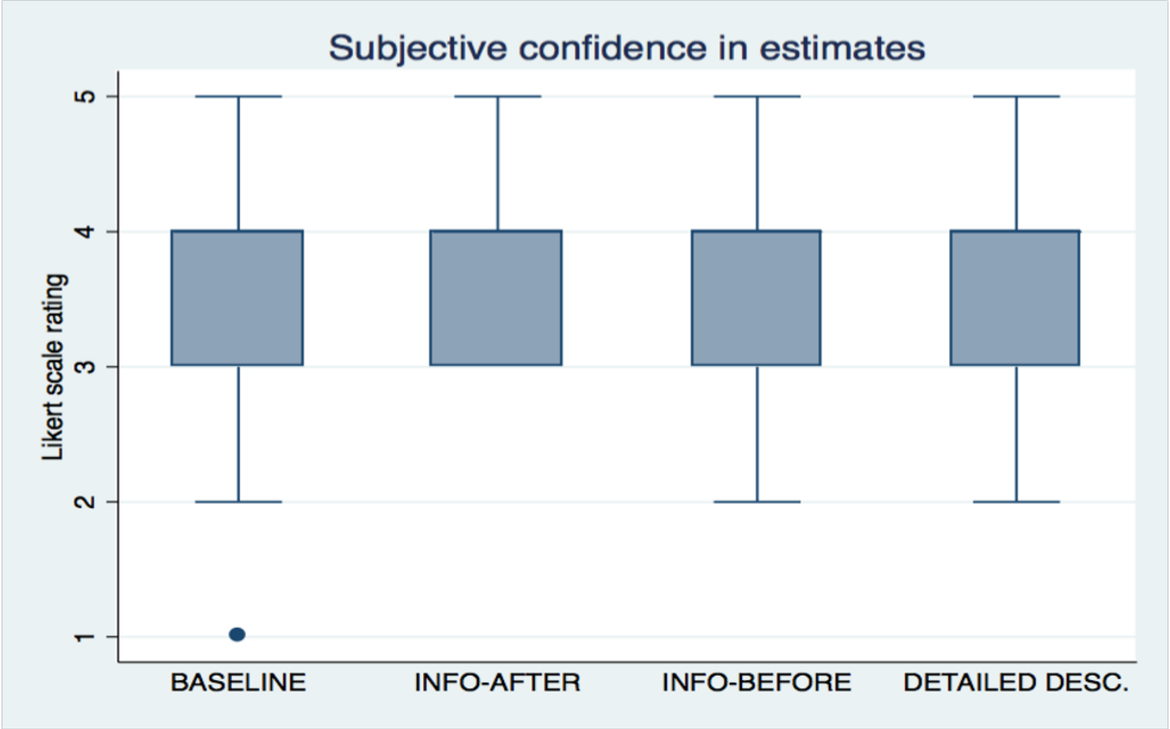
- real effort task: 10 matrices
- “each matrix contains 16 numbers” - not told that numbers are decimal
- Estimation accuracy earnings
- Task performance (speed) earnings

Results – estimates and actual duration



- Providing historical information as well as providing detailed task description significantly reduces the estimation bias.
- However, only the provision of historical information also significantly improves the estimation accuracy.

Results – subjective confidence in estimates



- Subjective confidence in estimates is not affected by the amount or detail of available information.
- Subjects display similar level of confidence regardless of what they know about the task.
- “What you see is all there is” (Kahneman, 2011)
- Subjects willing to pay more after experiencing the benefits of historical information.

People respond to incentives

- While psychology provides a lot of different and fruitful answers to why people are doing what they are doing, one economic reason always stands out – people respond to incentives.

- Whenever you see somebody acting weird or ” irrational”, take a step back and ask yourself – “Is it possible that he knows exactly what he is doing? Maybe it is just me not understanding his incentives.”

- Once you understand the incentives, you may be surprised how rational the choices may be.

STUDY 3 - Hidden inefficiency: Strategic inflation of project schedules

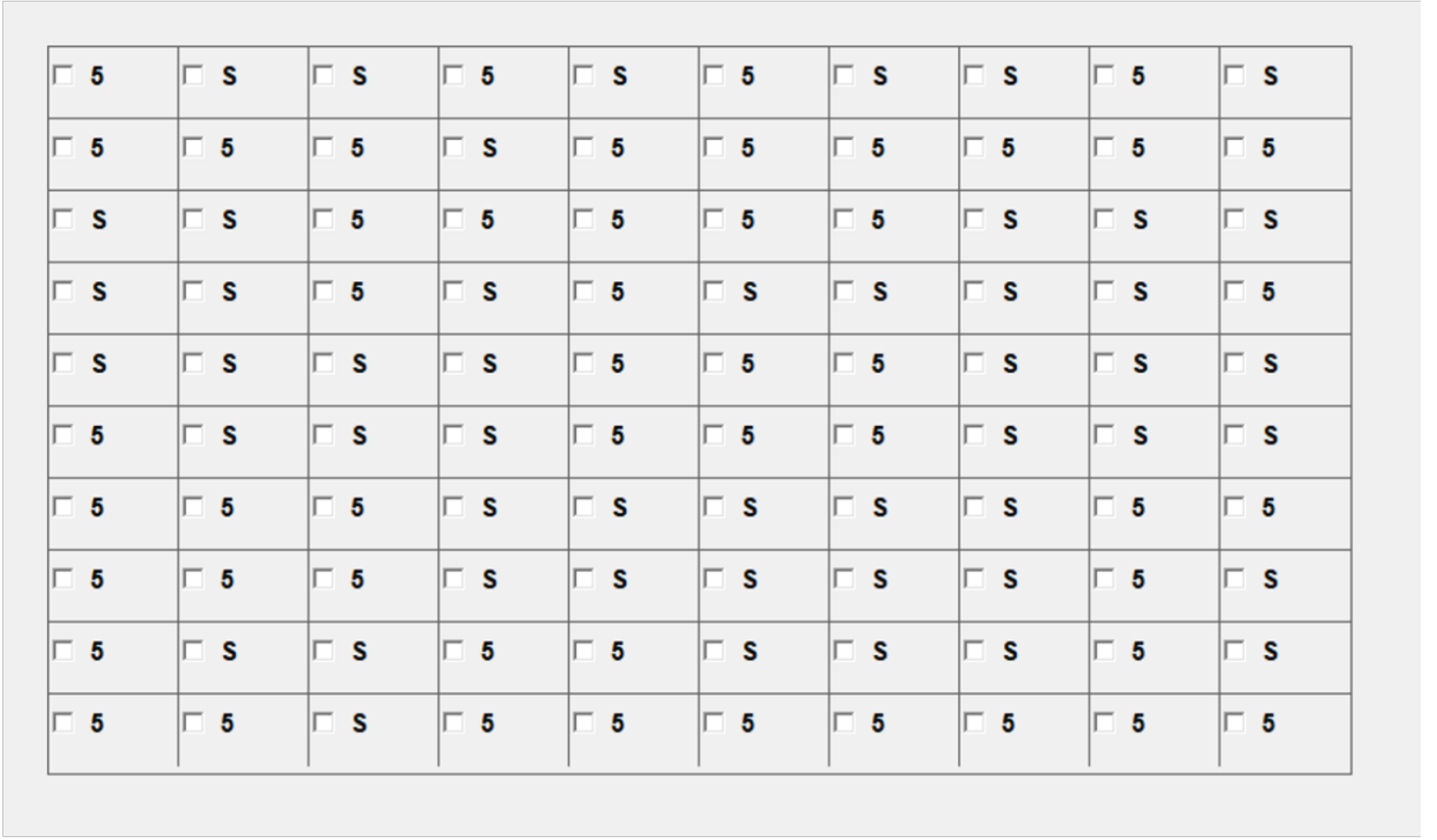
- Organizations prefer to have projects delivered not only on time, but also as quickly as possible.
- Nevertheless, operational efficiency may not be the primary concern of project planners
- Incentives to underestimate (e.g. to get a contract)
  - with a plan to alter the contract and get additional time/money approved once the project is on
- Incentives to overestimate (and subsequently overspend)
  - companies in a highly concentrated market - due to the lack of competition.
  - individuals – to be given loose timeframe to complete the task

STUDY 3 - Hidden inefficiency: Strategic inflation of project schedules

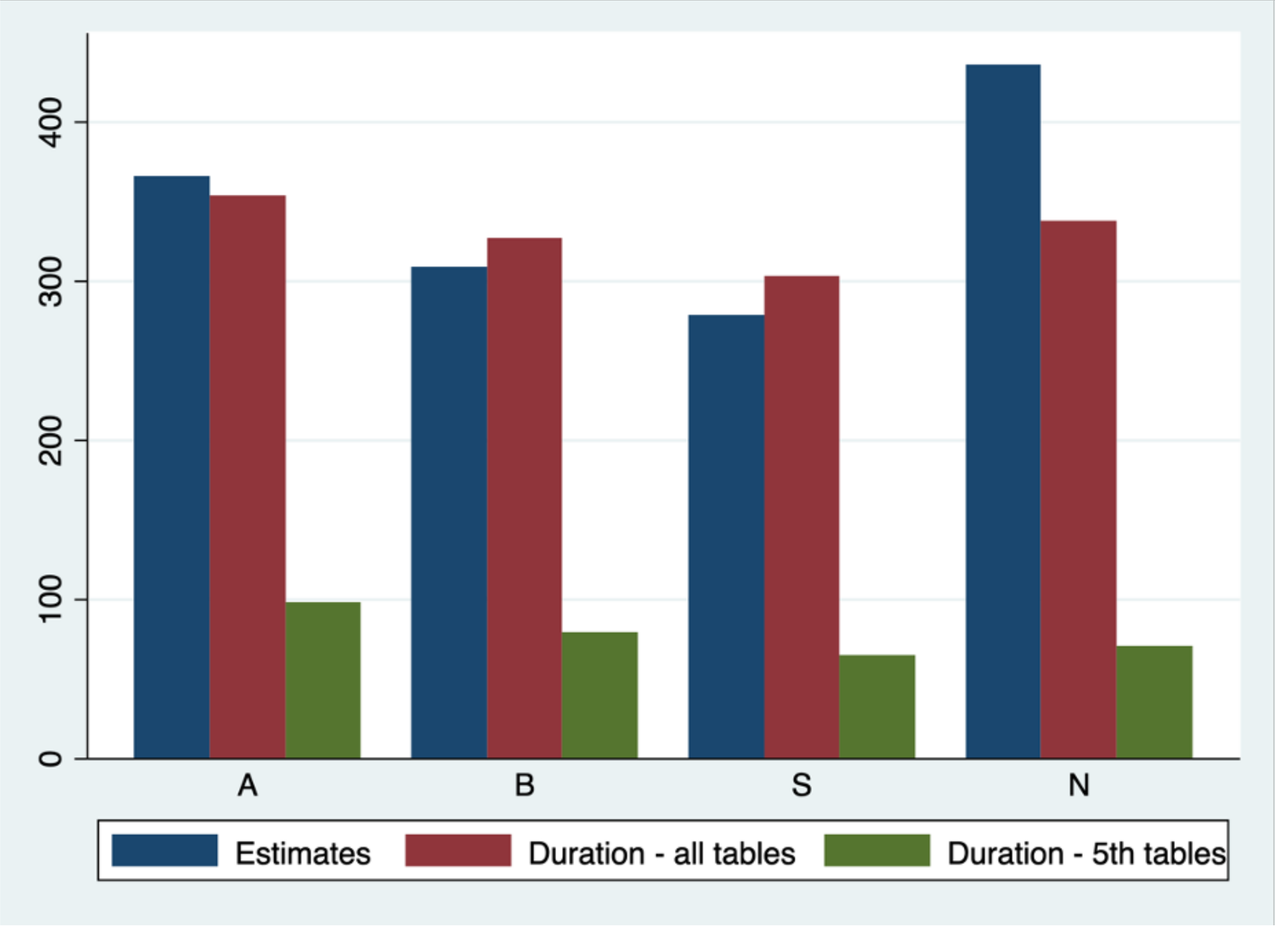
- “At times, the estimate is not estimate at all, but just a reflection of maximum time, that is believed to be still acceptable by the project customer.”
- Since projects delivered on time are usually considered successful, they rarely spark suspicion without which it might be difficult to uncover the inefficiency.
- Deliberate inflation of project schedules and subsequent prolonged execution present a hidden inefficiency for organizations.
- Conjectures
  - (1) an incentive structure aimed at increasing the estimation accuracy triggers strategic inflation of estimates and subsequent slower task execution
  - (2) adding speed incentives alongside the accuracy incentives results in lower task duration estimates and faster task execution, mitigating the hidden inefficiency

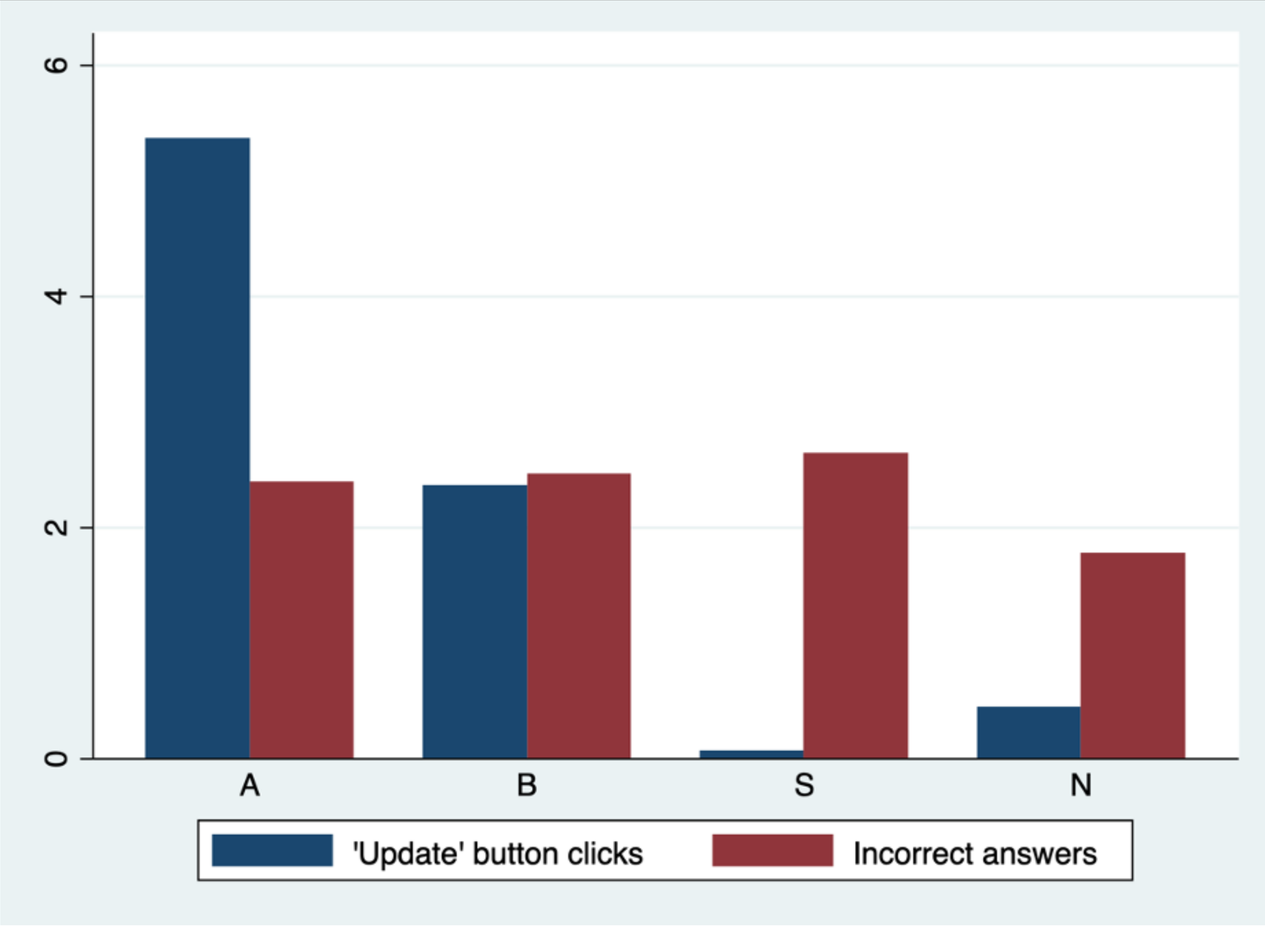
Experimental design

- Simple real effort task (search for symbols on 5 screens)
- 4 treatments
  - A: accuracy-only incentives
  - B: both accuracy and speed incentives
  - S: speed-only incentives
  - N: no incentives
- Subjects estimate time to complete the task and execute it for 3 times
- Practice table at the beginning
- Time measuring tool available

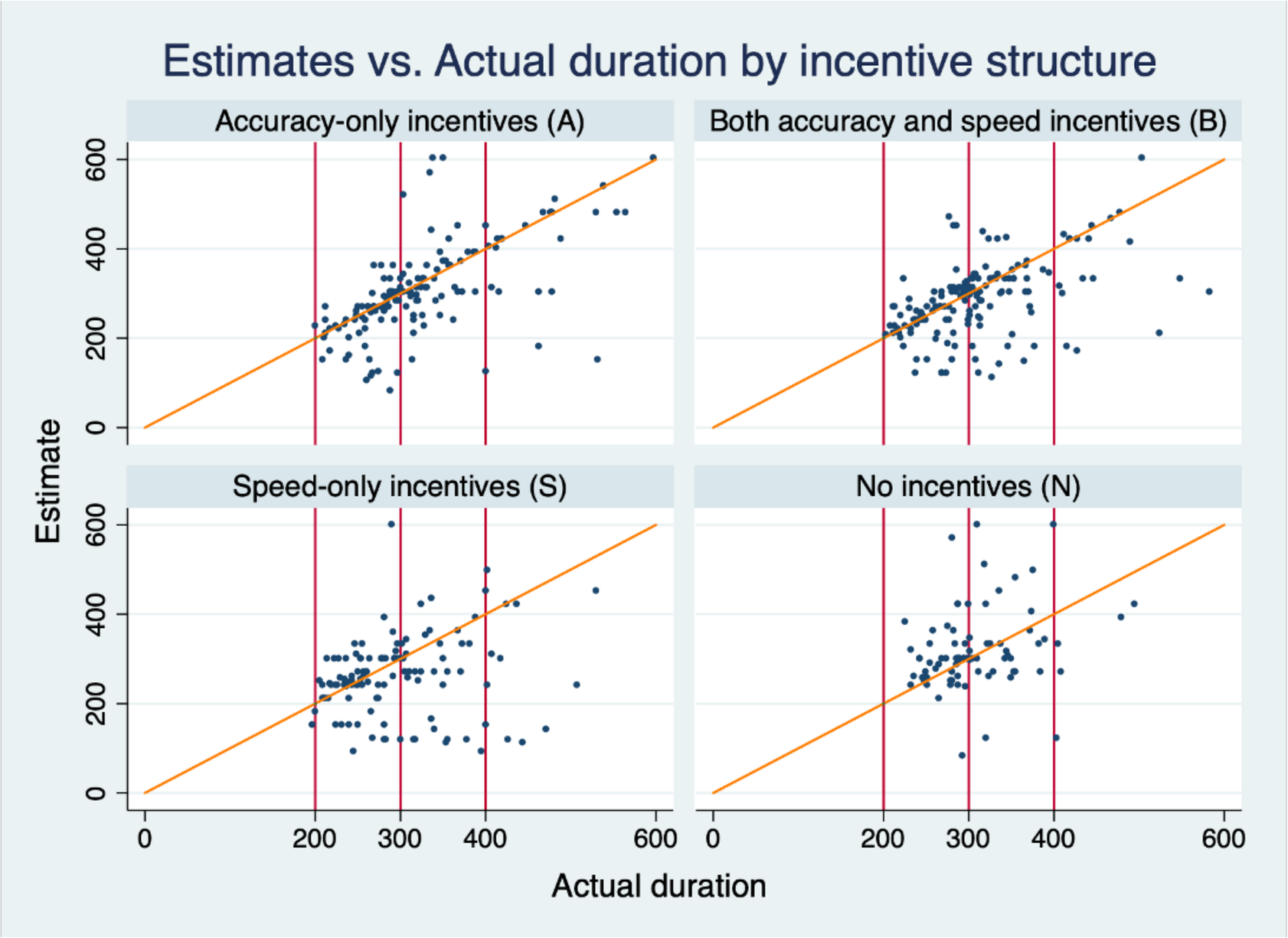


Results

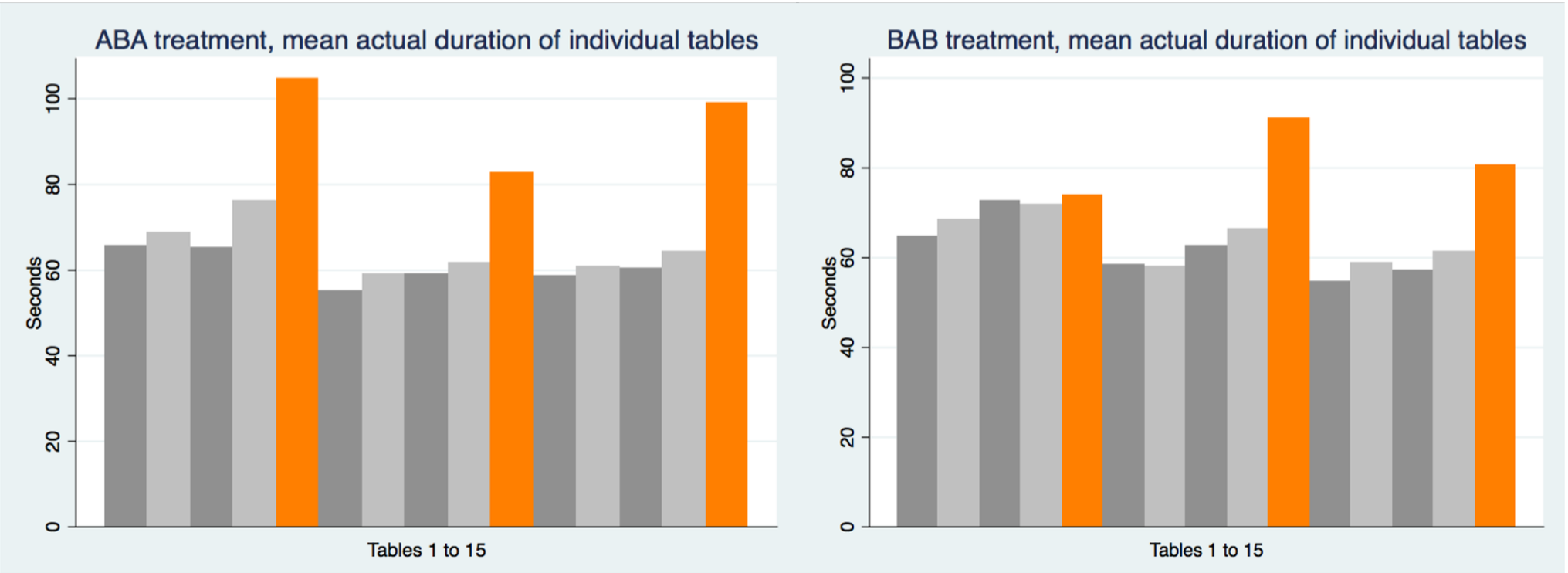

0
100
200
300
400
A
B
S
N
Estimates
Duration - all tables
Duration - 5th tables


0
2
4
6
A
B
S
N
'Update' button clicks
Incorrect answers

Results


Estimates vs. Actual duration by incentive structure
Accuracy-only incentives (A)
Both accuracy and speed incentives (B)
Speed-only incentives (S)
No incentives (N)
Estimate
0
200
400
600
0
200
300
400
600
Actual duration

Results – strategic pacing



- Subjects deliberately inflate their estimates and subsequently take longer to finish task then necessary, especially if they are only rewarded for the accuracy of their estimates.
- Subjects spend more time to figure out the best estimation strategy when facing two types of incentives.
- Subjects attend more carefully to the elapsed time when being rewarded only for estimation accuracy.

Conclusions

- Project duration estimation is different from most of other types of estimation or forecasting because the person or company producing an estimate de facto estimates own future performance. Such a situation opens room for both self-deception biases (e.g. overconfidence, optimism) and self-serving techniques (e.g. strategic misrepresentation of estimate and/or performance).

- In our research program “Economic Experiments in Project Management” we found that

  - anchors (including own estimates) can induce strong and systematic biases in project estimates that do not vanish even after the project has been repeatedly estimated and executed.

  - providing historical information (unlike providing detailed specification) can significantly mitigate the underestimation bias and improve the estimation accuracy

  - subjective confidence in the accuracy of duration estimates is neither a function of the quantity nor the quality of available information prior to estimation.

  - individuals can strategically respond to being rewarded for the accuracy of project schedule by providing inflated project duration estimates and prolonging the project execution

  - adding incentives for quick project completion can induce more compressed schedules and accelerated project delivery