

Research Task / Overview

Two types of risk in collaborative projects:

- **Systemic:** cost, schedule, and technical uncertainty

- **Collaborative:** conflict and coordination failures

Need improved methods to assess collaborative risk

- Identify and avoid poor strategic dynamics early

- Improve strategic decision-making to balance:

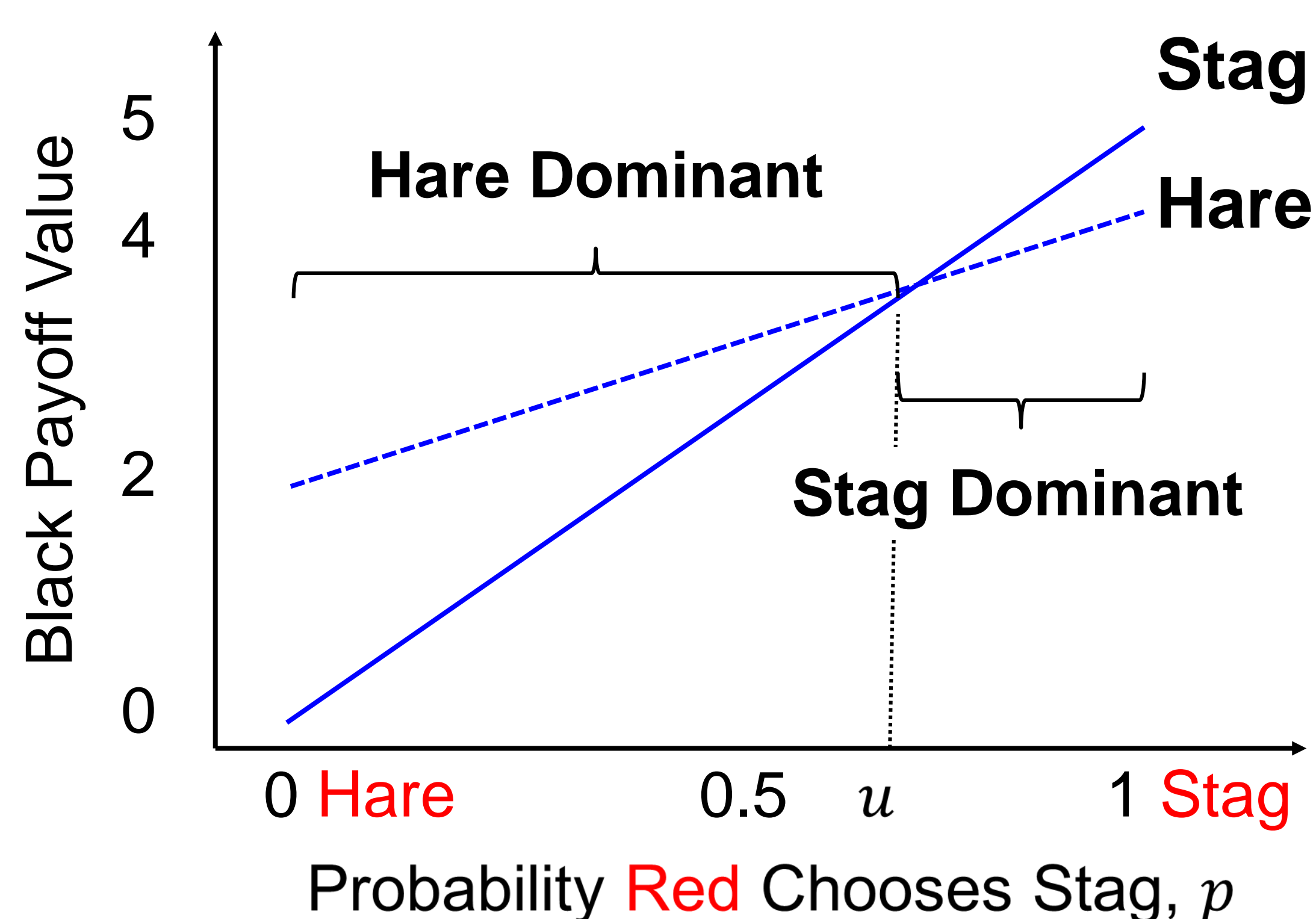
- Efficiency (feasibility)
- Effectiveness (desirability)
- Stability (viability)

Methodology

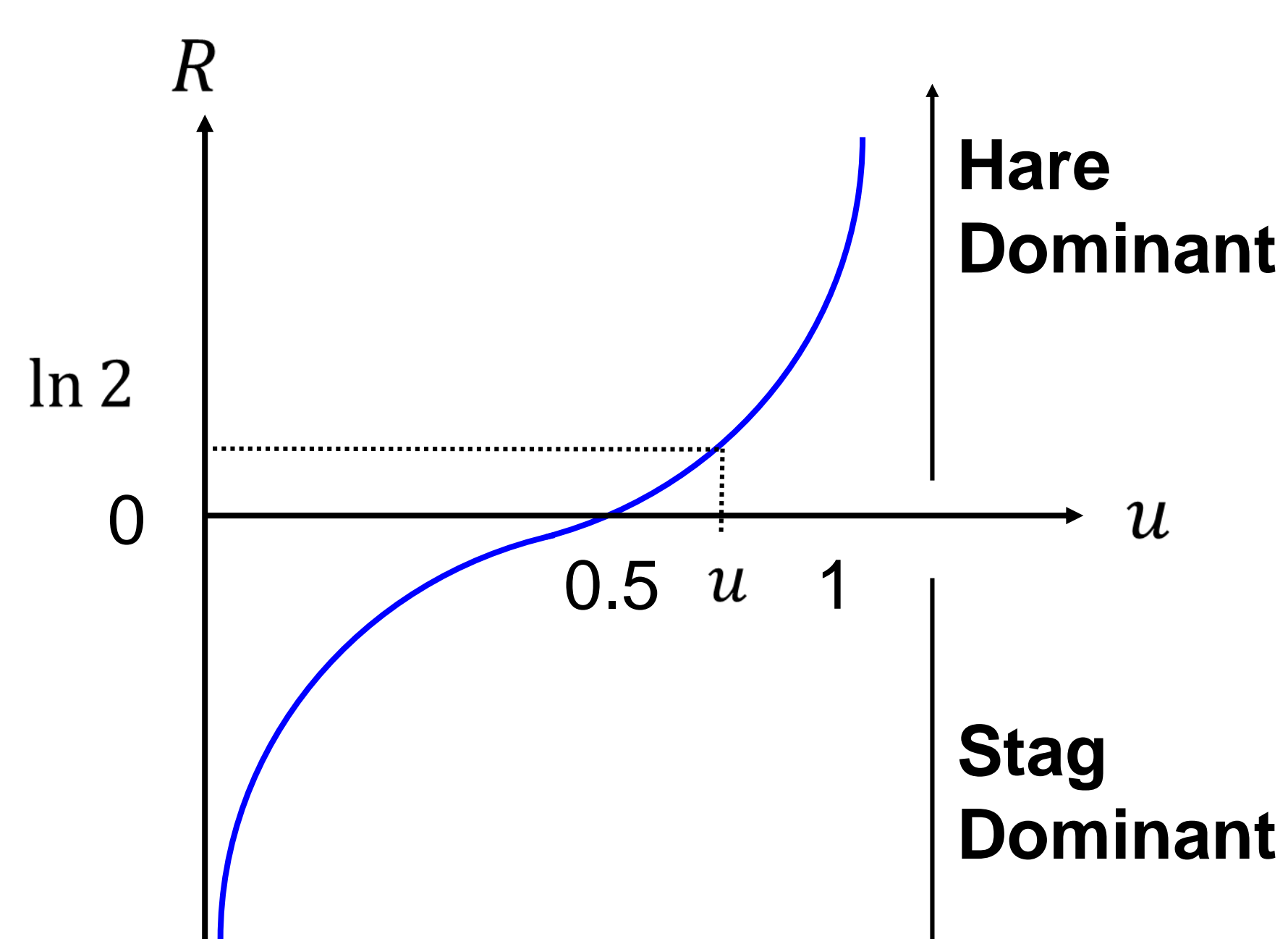
Foundation: Stag Hunt Game

- Two pure Nash equilibria
- Hare/Hare: risk-dominant equilibrium (minimize risk)
- Stag/Stag: payoff-dominant equilibrium (maximize reward)

	Hare	Stag
Hare	2, 2	4, 0
Stag	0, 4	5, 5



- u : Normalized deviation loss, $u = \frac{(2-0)}{(2-0)+(5-4)} = \frac{2}{3}$
- Selten's weighted average log measure $R = \ln\left(\frac{u}{1-u}\right)$



$$R = \ln\left(\frac{2/3}{1-2/3}\right) = \ln\left(\frac{2-0}{5-4}\right) = \ln 2$$

- Two approaches to reduce collaborative risk:
 1. Increase upside potential (denominator)
 2. Decrease downside risk (numerator)

Goals & Objectives

How to formulate and assess collaborative risk in distributed systems?

- Trade upside potential with penalty for failure
- Evaluate metric based on Selten's Weighted Average Log Measure of risk dominance

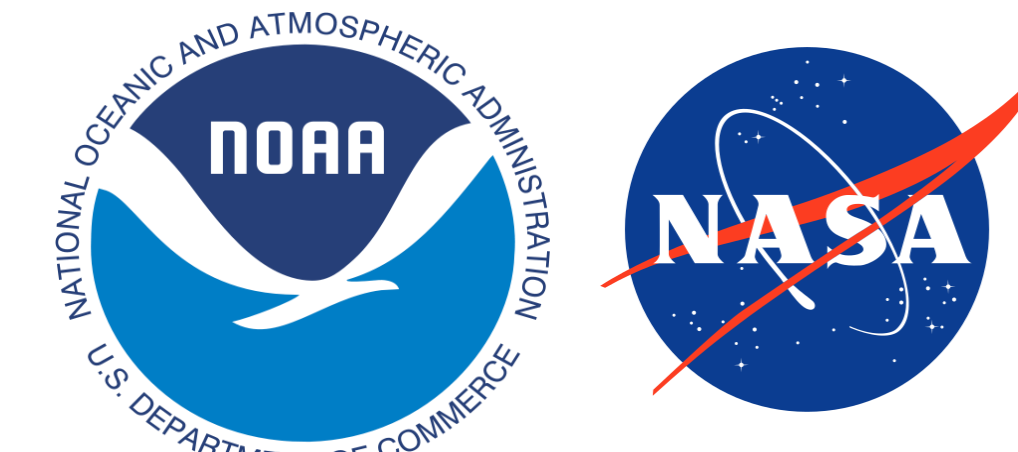
How can a collaborative risk metric be operationalized to evaluate a joint program?

- Develop scenario narrative based on NPOESS
- Assess collaborative risk using historical data

Application Case

Study how the collaborative risk dominance metric can be applied to a realistic systems design problem

- Independent designs based on historical programs
- U.S. Dept. of Defense: Defense Meteorological Satellite Program (DMSP)
- U.S. Dept. of Commerce/NOAA: Polar-orbiting Operational Environmental Satellite (POES)
- Joint program: National Polar-orbiting Operational Environmental Satellite System (NPOESS)



	POES	NPOESS
DMSP	DMSP	DMSP
NPOESS	(DWSS) POES	(JPSS) NPOESS

Future Research

- Model alternative architectures/designs
- Simulate key performance attributes: measurements, revisit period, data latency, cost
- Model multi-actor value preferences
- Fill game-theoretic matrix and assess collaborative risk dominance for baseline case

Contacts/References

Paul T. Grogan, pgrogan@stevens.edu, 201-216-5378
Collective Design Laboratory, code-lab.org
Stevens Institute of Technology