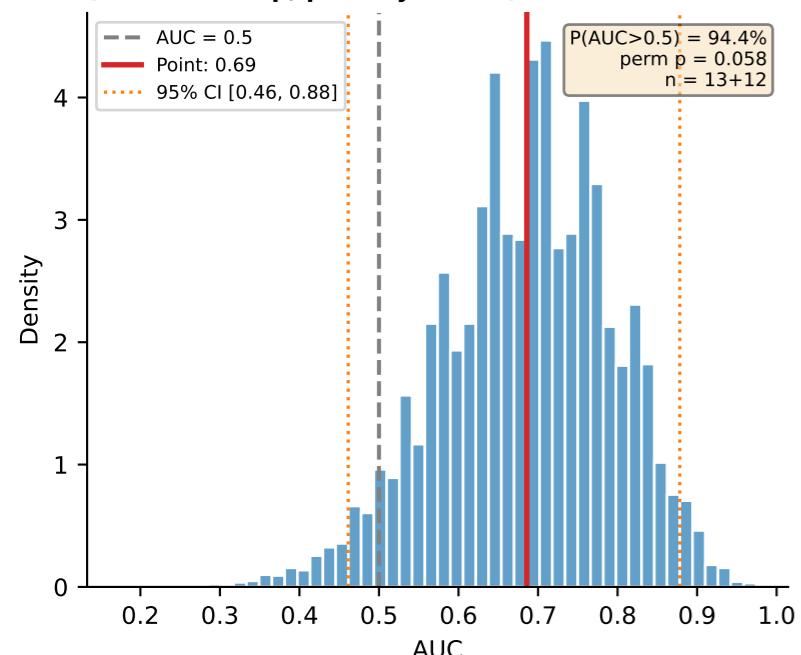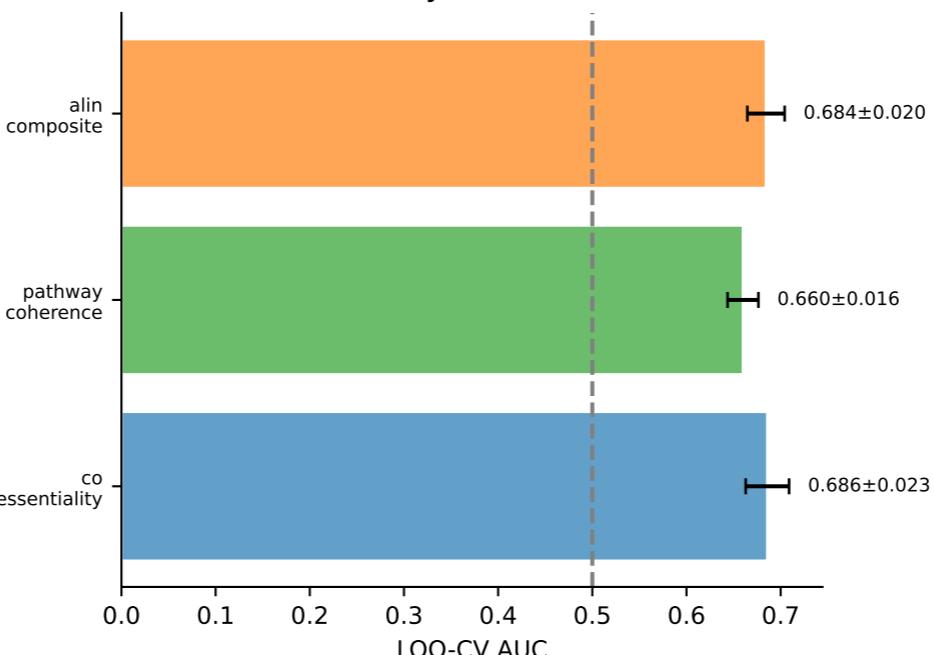**Supplementary Figure S13: Hardened Outcome-Oriented Benchmarks**
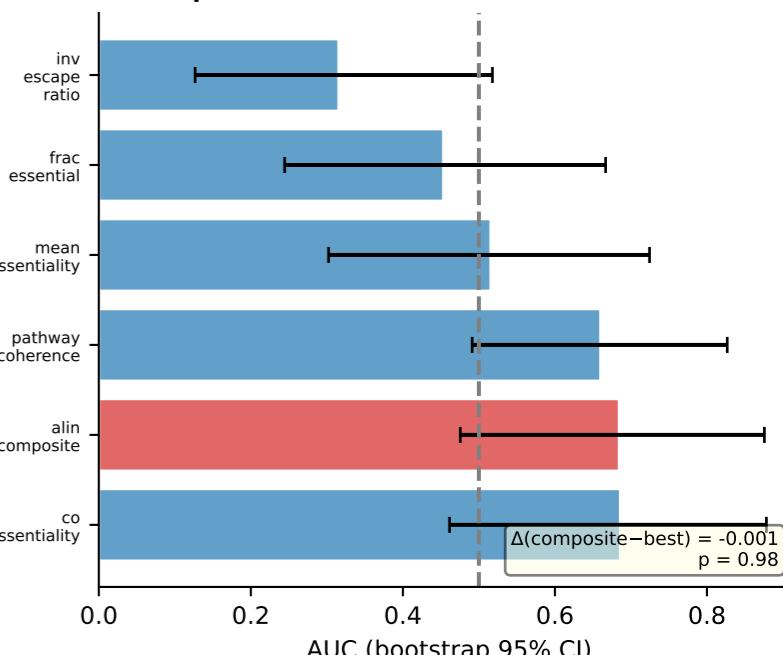
A Co-essentiality AUC (10k bootstrap, primary metric)

- AUC = 0.5
- Point: 0.69
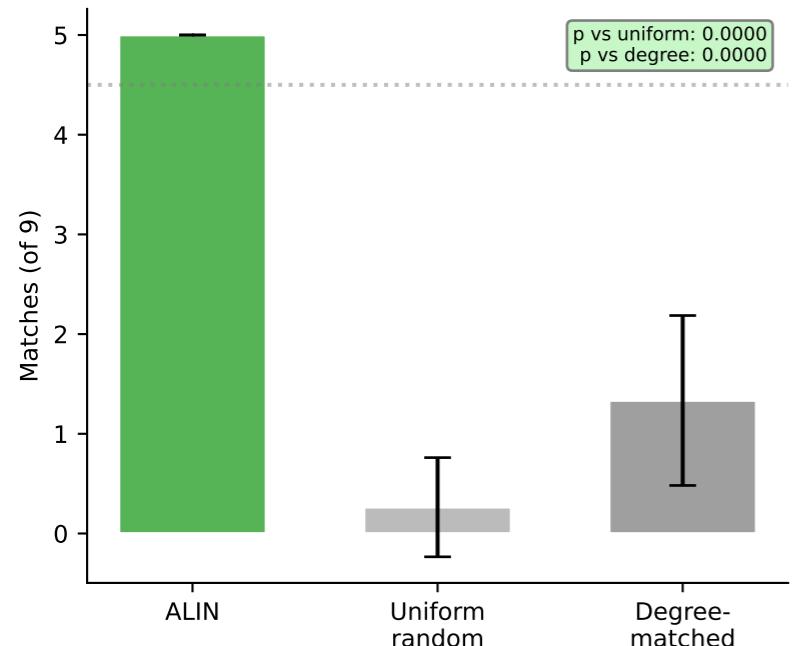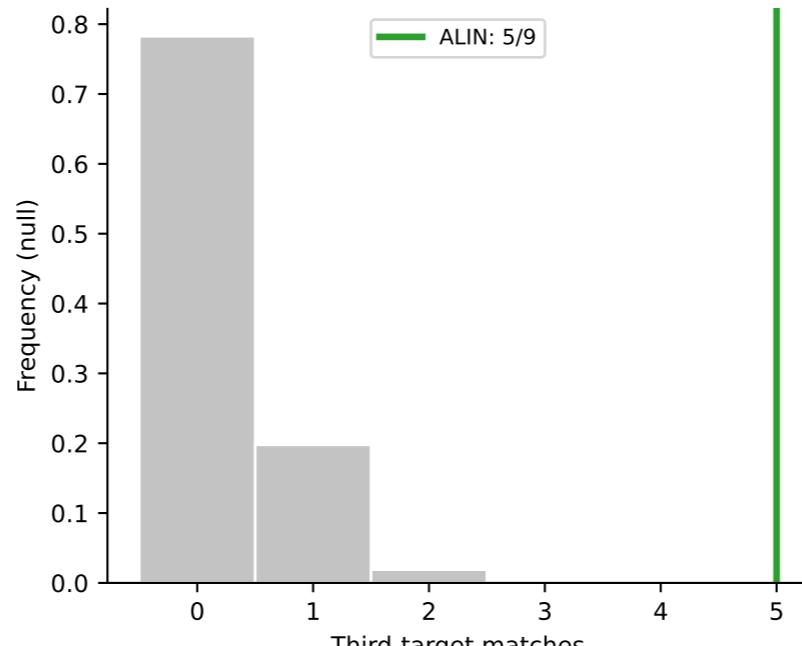- 95% CI [0.46, 0.88]

P(AUC>0.5) = 94.4%
perm p = 0.058
n = 13+12

B LOO-CV AUC stability

- alin composite: 0.684±0.020
- pathway coherence: 0.660±0.016
- co essentiality: 0.686±0.023

C Composite vs individual AUCs

- inv escape ratio
- frac essential
- mean essentiality
- pathway coherence
- alin composite
- co essentiality

Δ(composite−best) = -0.001
p = 0.98

D Third-target: ALIN vs baselines

p vs uniform: 0.0000
p vs degree: 0.0000

ALIN, Uniform random, Degree-matched

E Null distribution (uniform random)

ALIN: 5/9

F Summary statistics

Metric	Value	95% CI	p
Co-ess AUC	0.686	[0.46, 0.88]	0.0584
Pathway AUC	0.660	[0.50, 0.83]	0.0625
Composite AUC	0.684	[0.47, 0.88]	0.0423
3rd-target	5/9	vs 0.3 random	0.0000
Δ(comp−best)	-0.001	[-0.244, +0.250]	0.98