# Methods – Inequality Inertia Simulation Model

This document describes the methods used to implement an agent-based simulation of systemic bias and corrective interventions, designed to illustrate the persistence of inequity without active intervention and the effects of positive discrimination.

## 1. Model Overview

The model simulates two population groups: A (privileged, e.g., majority group) and B (under-represented). Each agent belongs to one of these groups and is either in the 'power tier' (P) or the 'non-power tier' (N). Agents have a capital score representing resources, skills, or networks, which influences their chance of entering or remaining in P.

## 2. Selection Model

At each time step, a fixed number of slots in P open. Agents in N are considered for selection based on their capital and bias parameters. The base selection weight is:

w\_i = exp(k \* c\_i)

where c\_i is the agent's capital and k is a scaling parameter.  
Bias modifies weights as follows:

w\_i = w\_i \* (1 + β) if agent is A  
w\_i = w\_i \* (1 - β) if agent is B

Positive discrimination (intervention) modifies B's weights further:

w\_i = w\_i \* (1 + τ) if agent is B

## 3. Policy Types

Two intervention modes are supported:  
1) Weighted: Soft affirmative action multiplying weights for B.  
2) Quota: Enforcing a minimum share of B among selected agents.

## 4. Feedback Dynamics

After selection, agents in P gain additional capital each step, representing increased access to resources and influence. All agents also receive a network spillover from the average capital of P.

c\_i(t+1) = c\_i(t) + α \* I[P] + γ \* mean(c\_P) + η\_i

where α is the resource boost in P, γ is the network spillover coefficient, and η\_i is random noise.

## 5. Retention and Exit

Agents in P may exit based on group-specific retention probabilities r\_A and r\_B. This models differences in staying power due to structural advantages or disadvantages.

## 6. Auto-Taper Intervention

An optional controller reduces τ when parity is achieved and stable over several time windows, checking representation gap, capital gap, and conditional selection parity.

## 7. Key Metrics

The simulation tracks:  
- Representation: Share of B in P vs. population share  
- Capital gap: Mean capital(A) – Mean capital(B)  
- Conditional selection gap: Difference in selection rates for equally qualified A and B  
- Intervention level τ over time