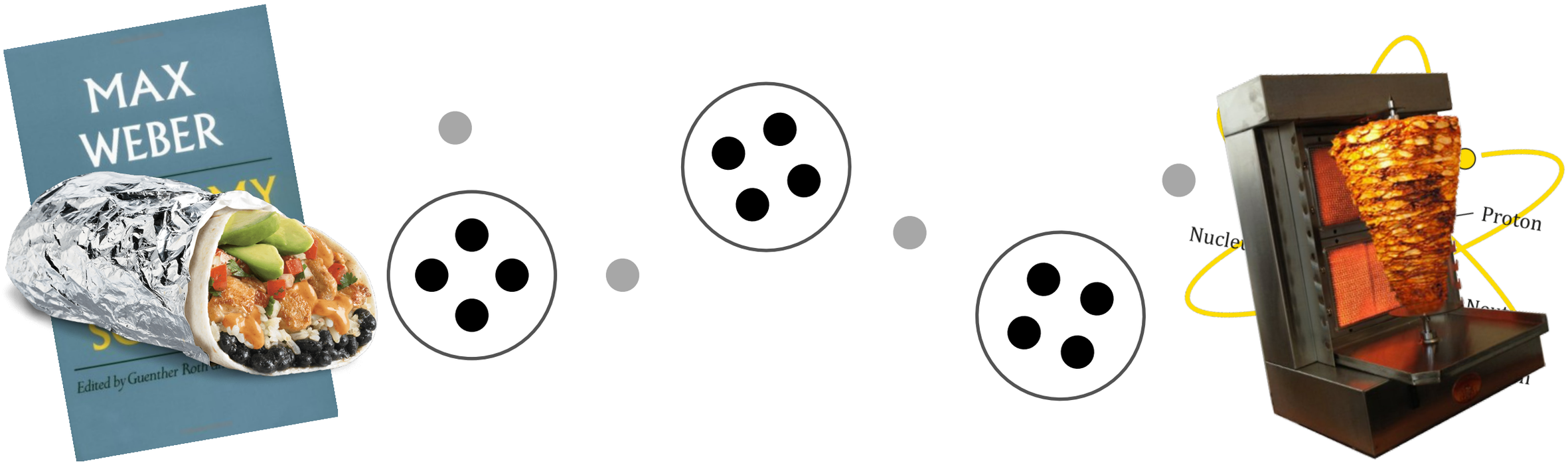
Producer Exploration Generates Categories without Audiences

Anthony Vashevko
INSEAD

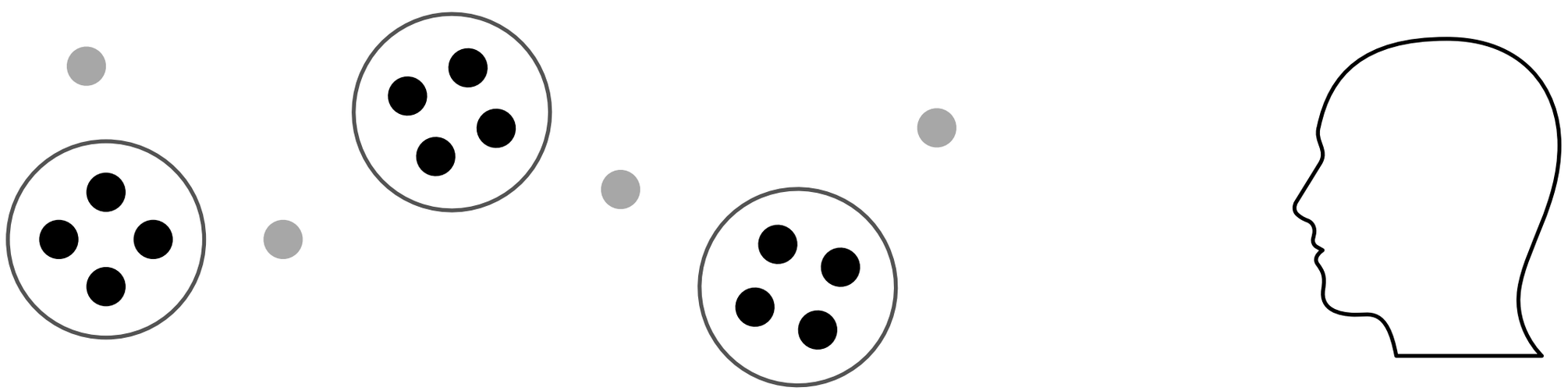
Market Categories

- Markets are partitioned into categories
- Markets penalize miscategorized objects
- Why clusters? Why penalty?



Market Categories: Category Theory

- Focus on:
  - Producers evaluated by audience (consumers, stakeholders, etc.)
- Penalty comes from market audience
  - Miscategorized objects are hard to evaluate, easy to ignore



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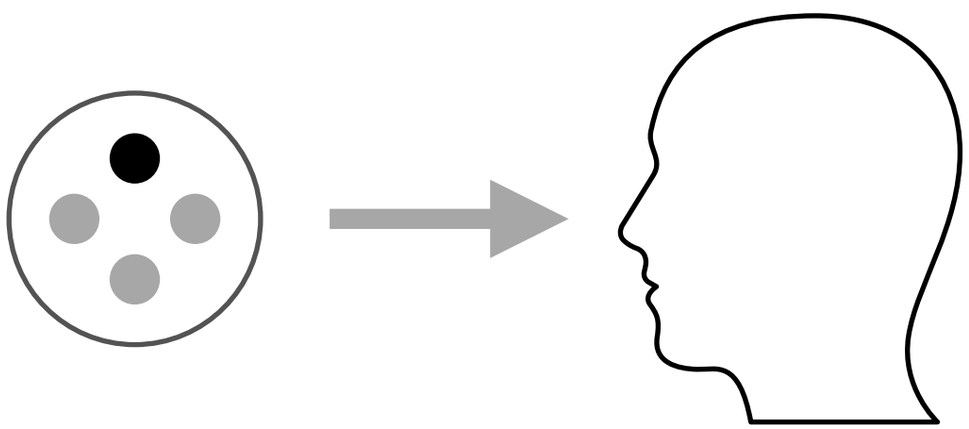
BA, Sociology
Minor, Ethnic Studies



Market Categories: Category Theory

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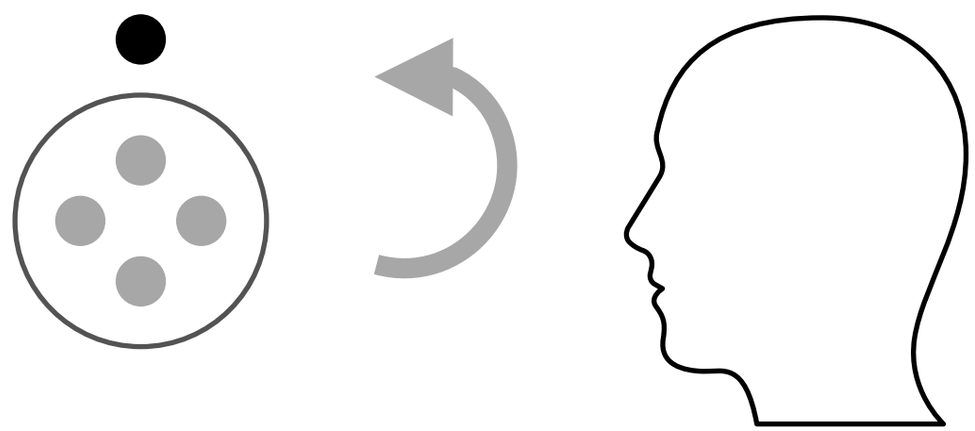


Market Categories: An Alternative

- Focus on:
  - Producers exploring competitive markets
  - Dynamic evolution of markets
  - Penalty comes from exploration of uncertain marketplace

stuff'd

mexican. turkish. delicious.

stuff'd

mexican. turkish. delicious.

QUESADILLA

Chicken	7.8
Beef Con Carne	8.3

BURRITO

Chicken	6.8
Beef Con Carne	7.3
Veggie	6.8

* Option of having it without tortilla, in a burrito bowl

KEBAB

Chicken	5.3
Beef Con Carne	5.8

Highly Recommended

Lower in calories — Lower calorie Kebab, Daily Bowl and Burrito Bowl (without wrap) options are available.

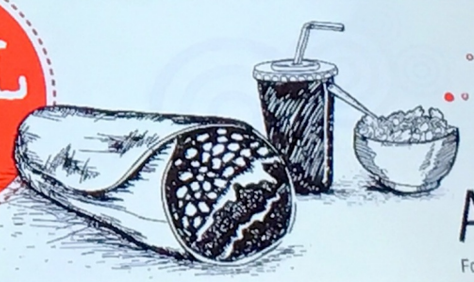
DAILY BOWL

Chicken	7.5
Beef Con Carne	8.0
Smoked Salmon	7.8

DRINKS & SIDES

Soft Drinks	1.5 | 2.0
Mash Potato	1.5
Corn Bowl	1.5
Black Beans	1.5
Couscous	1.5

MEAL IT



ADD 2.0

For ANY 12oz Drinks & Sides

Additional Base 1.0 + Hummus + Guacamole + Cheese

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SAMSUNG

Can grea
tasting

Market Categories: An Alternative

- Focus on:
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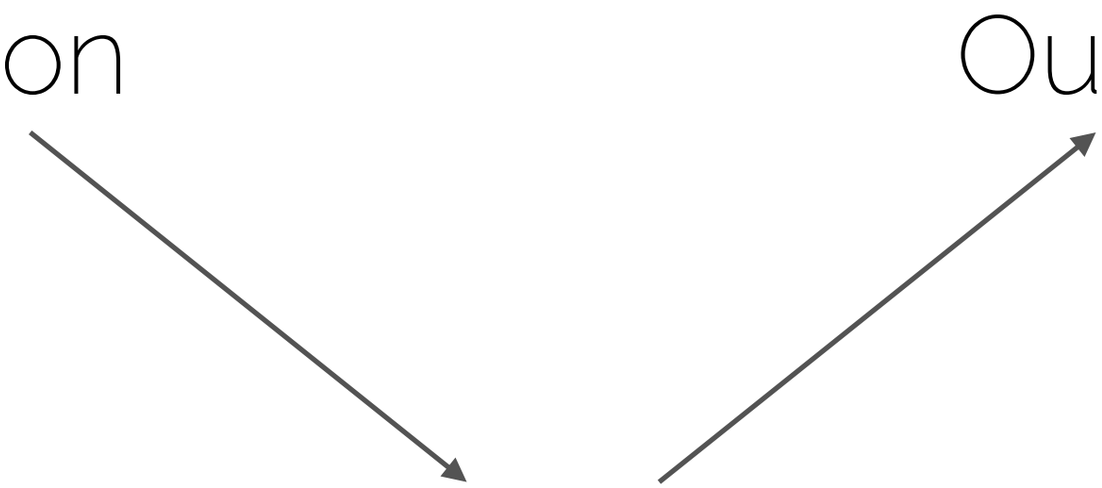
Market Categories: An Alternative

- Focus on:
  - Producers exploring competitive markets
  - Dynamic evolution of markets
- Penalty comes from exploration of uncertain marketplace
- Model replicates & extends category theory
  - Explains penalty, dynamics, emergence

Agenda

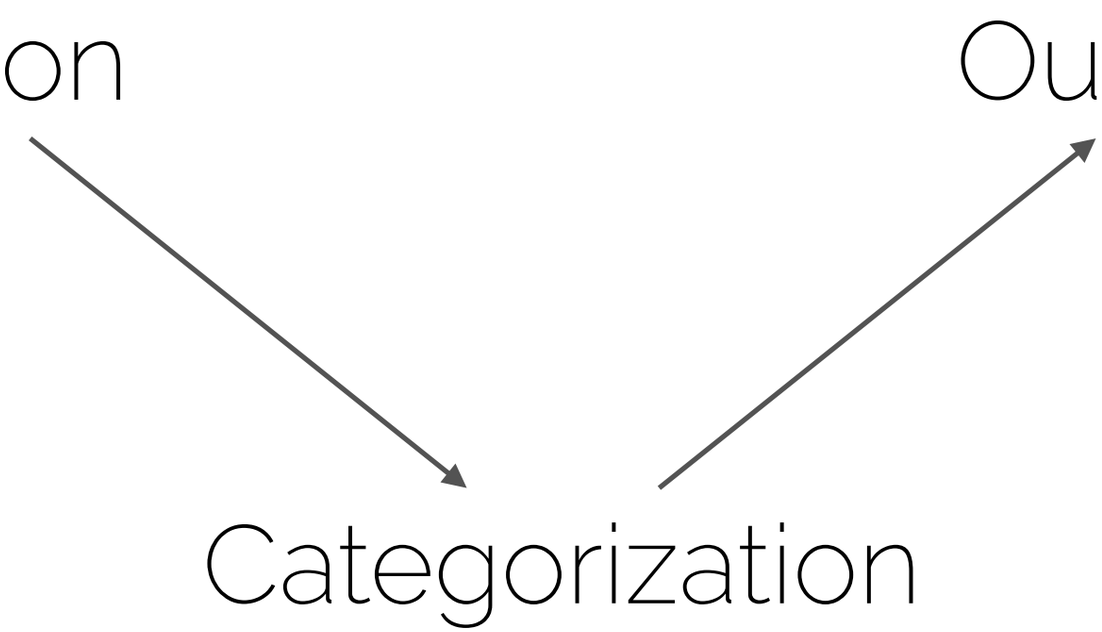
1. Findings of category theory
2. Alternate model and simulation
3. Replication and extensions

Category Theory



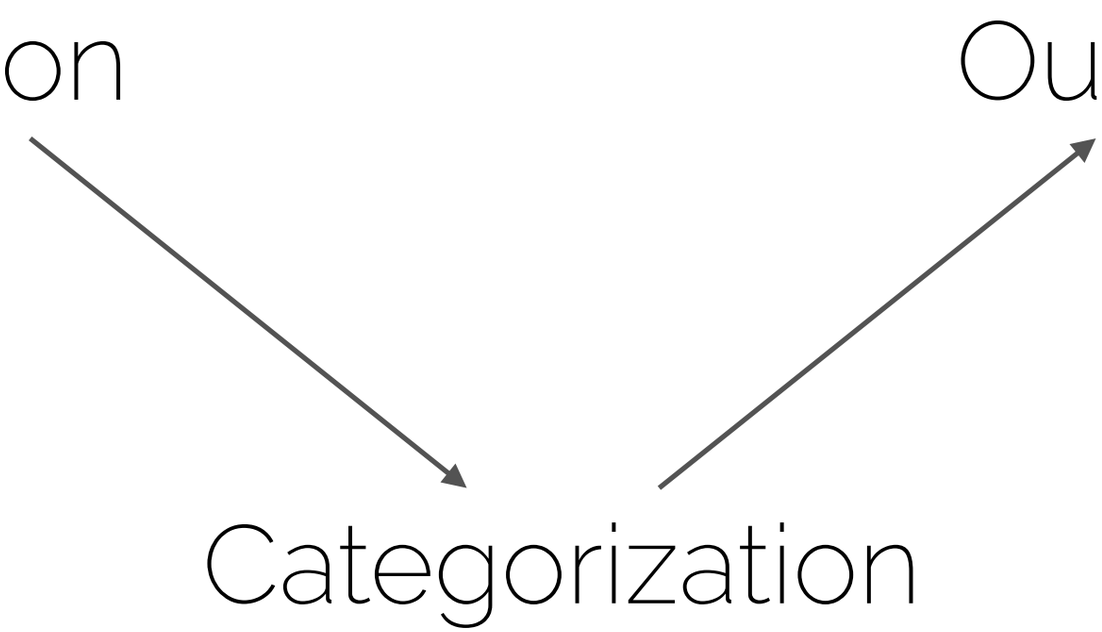
Category Theory

- Categorization predicts outcome
- Categorical boundaries can be fuzzy, ambiguous, etc.
- How can innovation exist given audience pressure?



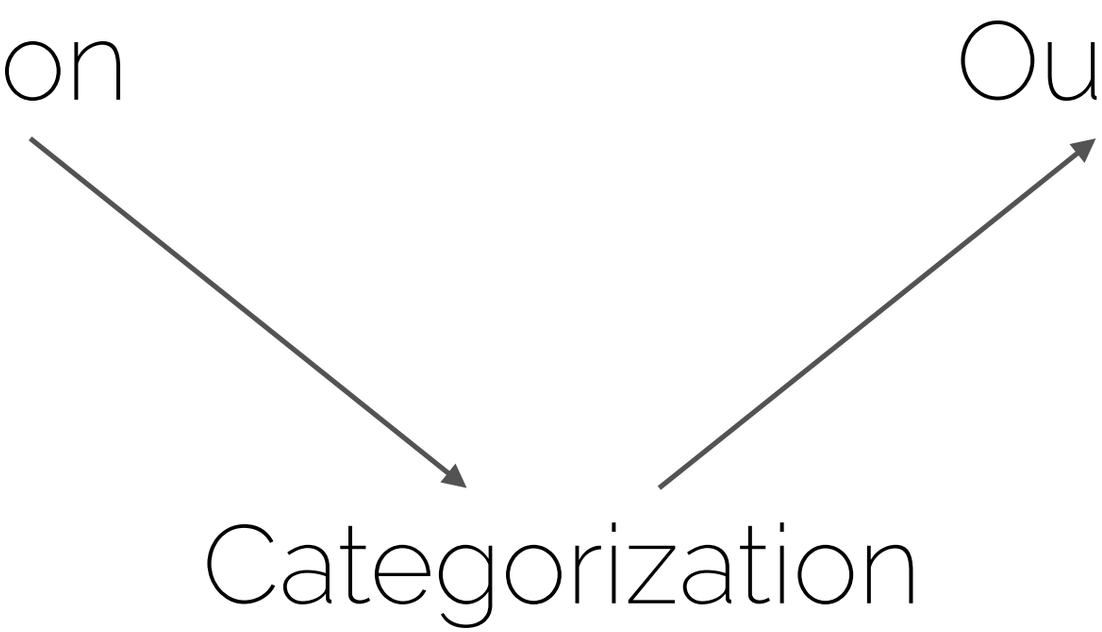
Category Theory

- Categorization predicts outcome
  - (Zuckerman 1999; Phillips, Zuckerman 2001; Hsu 2006)
- Categorical boundaries can be fuzzy, ambiguous, etc.
- How can innovation exist given audience pressure?



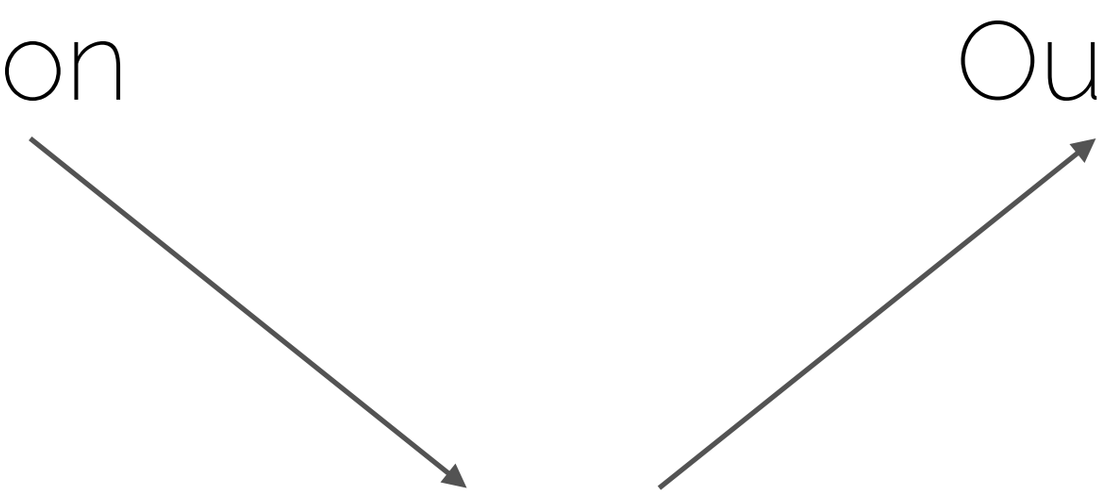
Category Theory

- Categorization predicts outcome
- Categorical boundaries can be fuzzy, ambiguous, etc.
  - Hannan, Polos, Carroll 2007; Pontikes 2012; Pontikes, Hannan 2014; Kovács, Hannan 2015
- How can innovation exist given audience pressure?



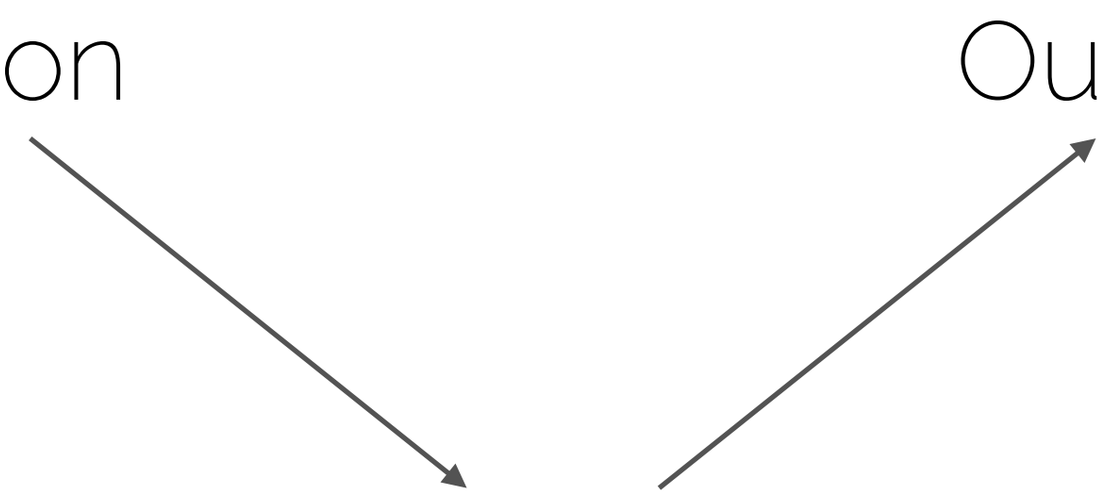
Category Theory

- Categorization predicts outcome
- Categorical boundaries can be fuzzy, ambiguous, etc.
- How can innovation exist given audience pressure?
  - Kennedy 2008; Bowers 2015; Kovács, Liu 2016; Zhao et al. 2018



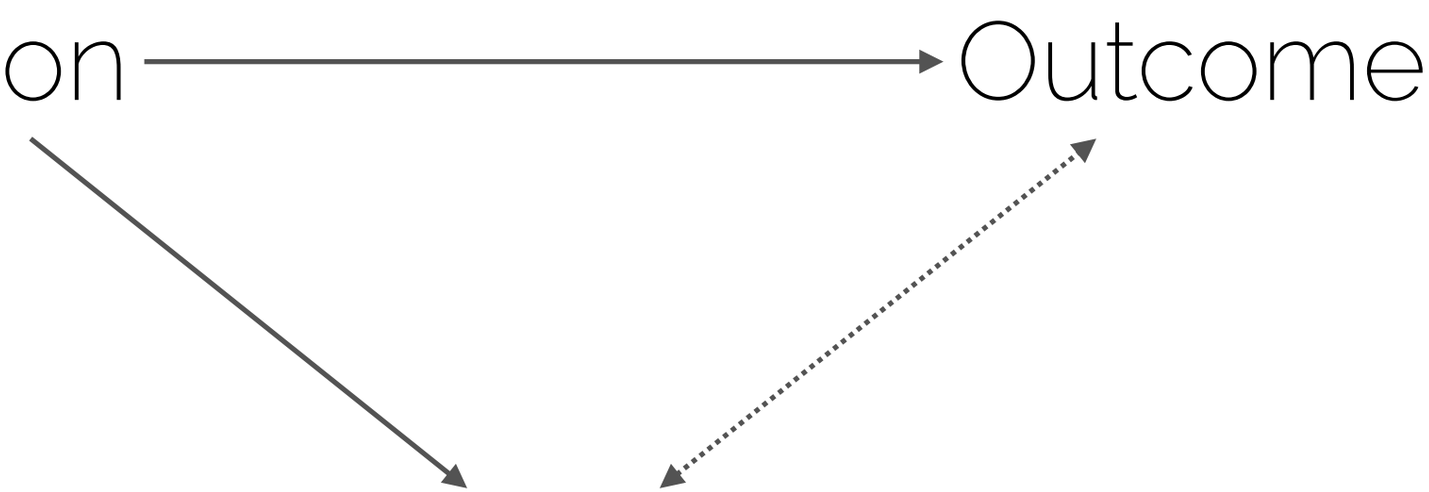
Category Theory

$$Outcome = \underset{<0}{\beta} \cdot Miscategorized + \ldots$$



Producer Exploration

$$Outcome = \underset{<0}{\beta} \cdot Miscategorized + \ldots$$



Optimal Differentiation

- Producers differentiate to avoid competition
  - but, world is uncertain
- Producers imitate to avoid uncertainty

Optimal Differentiation

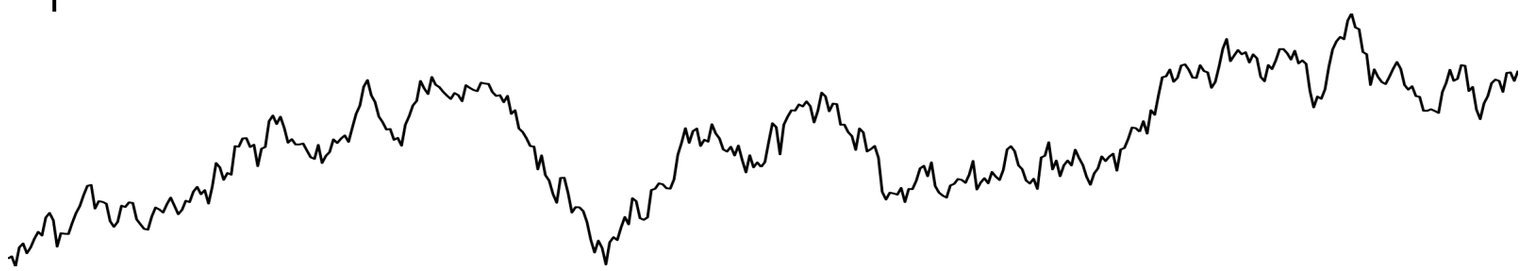
1. Producers learn from past examples
2. Success attracts density
3. Audience categorizes clusters of similar producers

Model Details

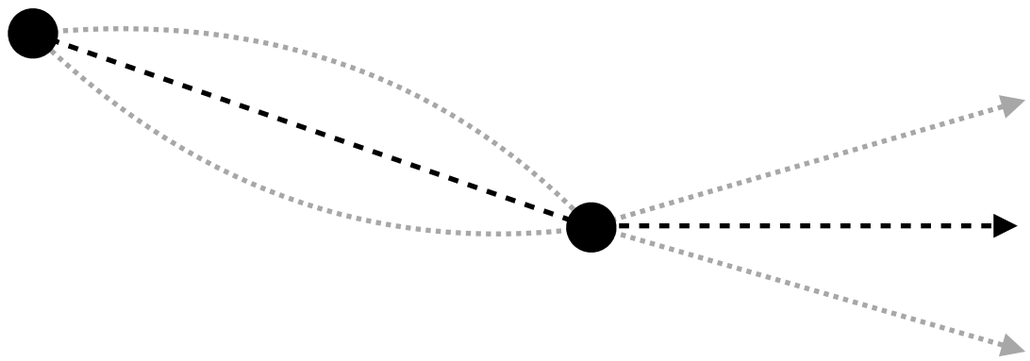
- Sequential entry into linear resource space
- Risk averse actors: $u(m) = am - \exp(-bm)$
- Competition: –1/(distance to neighbor)
- Complex environment: value of position is uncertain

Model Details

- Complex environment: Brownian walk



  - Distance from known points increases uncertainty



- Allows for arbitrary density, optimal entry

Appeal

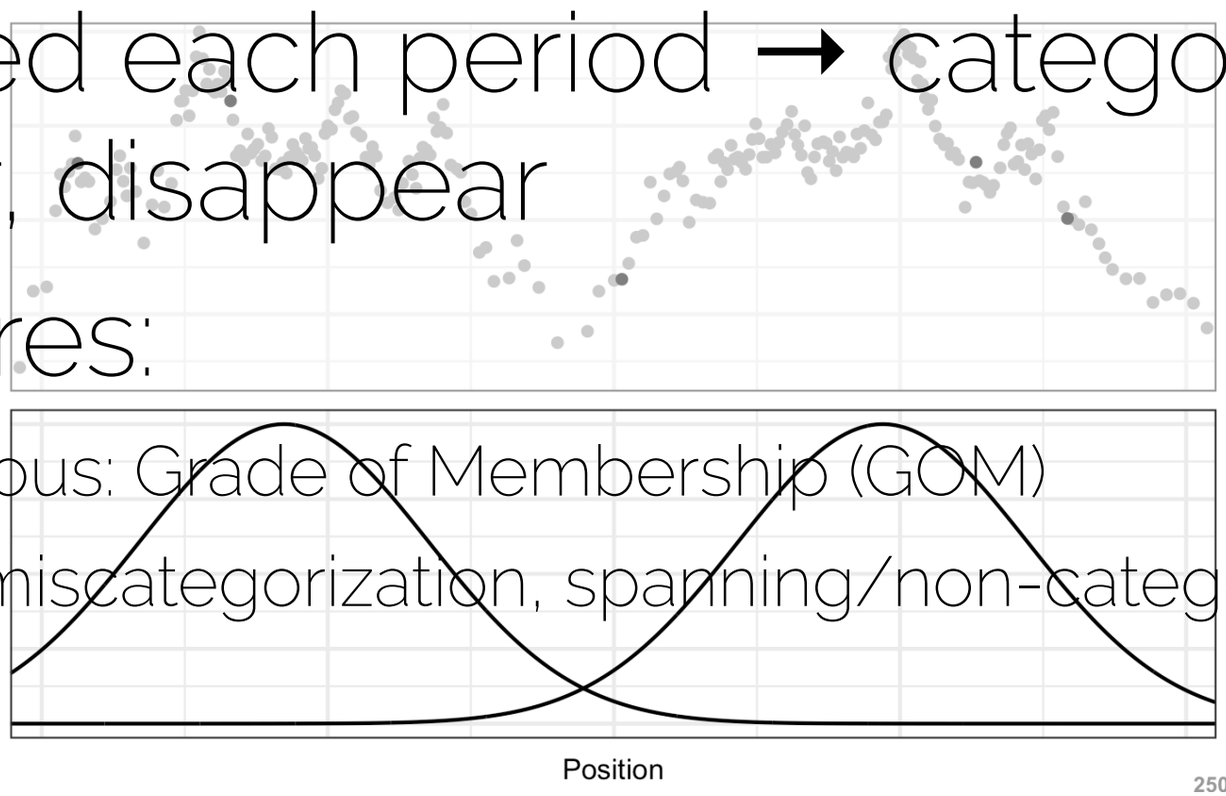
Cluster

Position

250

Model Details

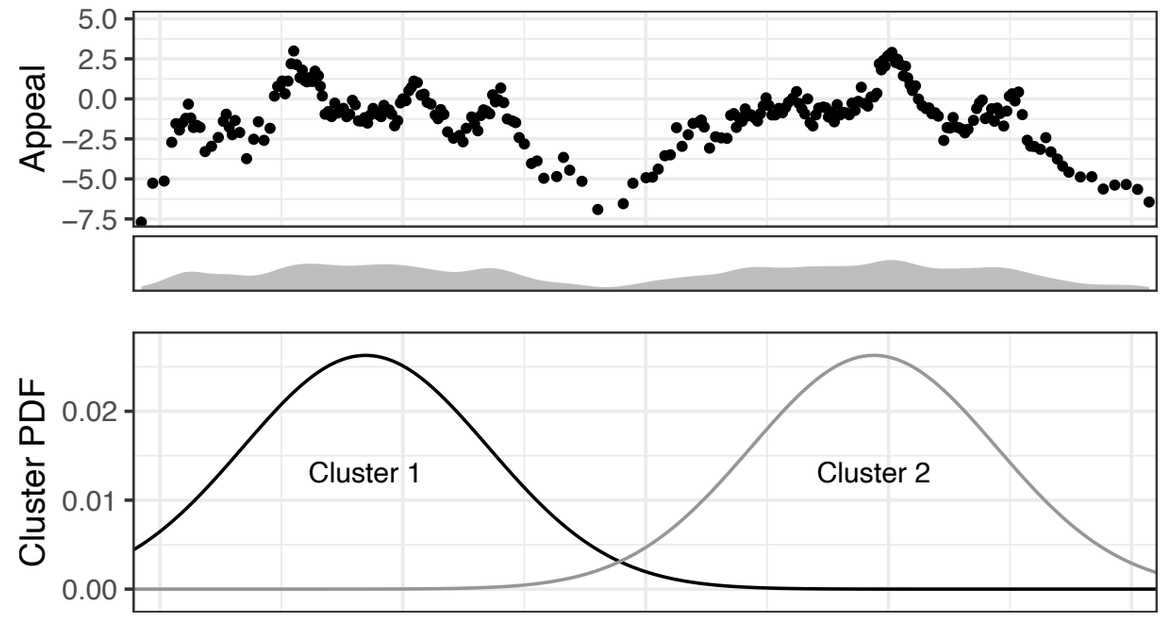
- Audiences naturally categorize similar objects
- Categories: Normal mixture model
- Updated each period → categories move, appear, disappear
- Measures:
  - Continuous: Grade of Membership (GOM)
  - Binary: miscategorization, spanning/non-categorization



Measures of Categorization

- Clusters from normal mixture model
  - Cluster pdf:

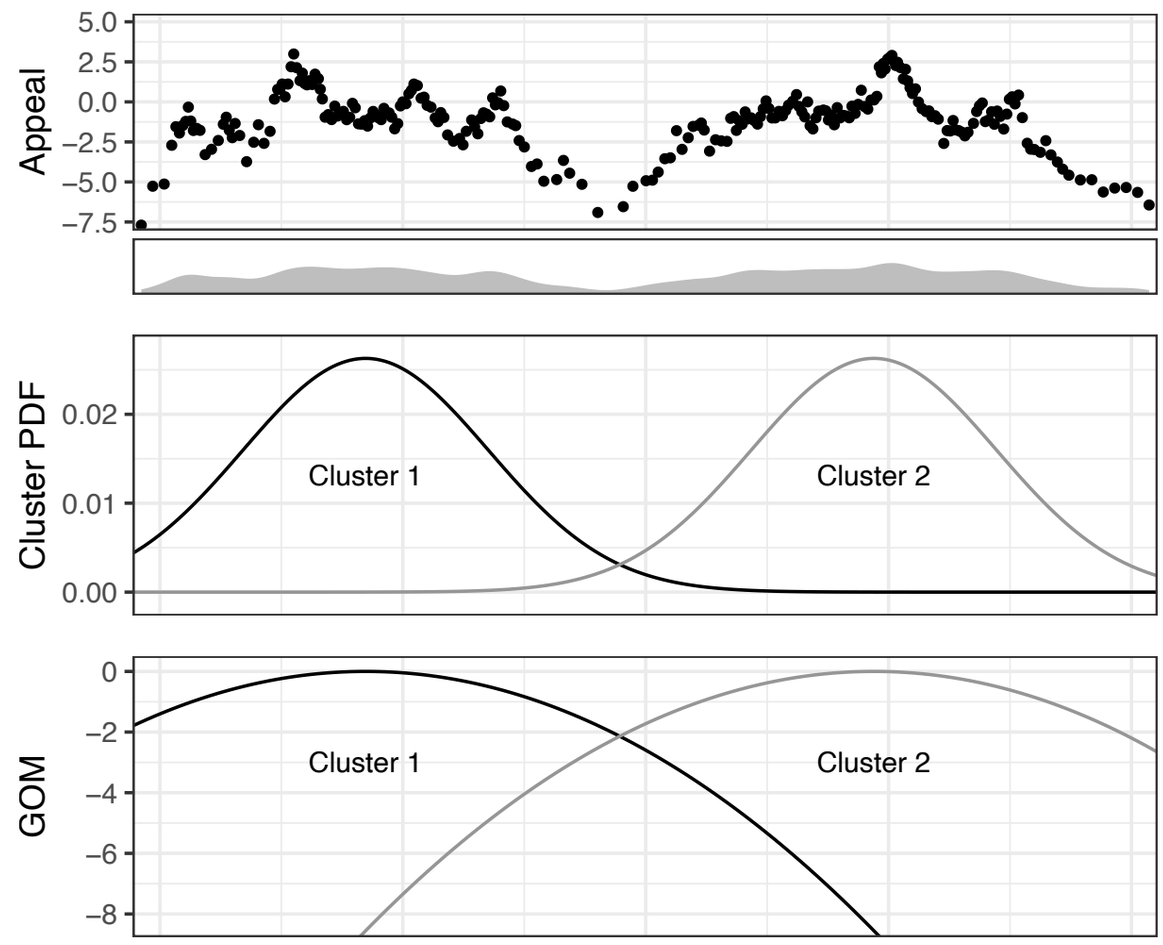
$$\phi_i(x)$$



Measures of Categorization

- GOM:

$$\max_i \log \phi_i(x)$$



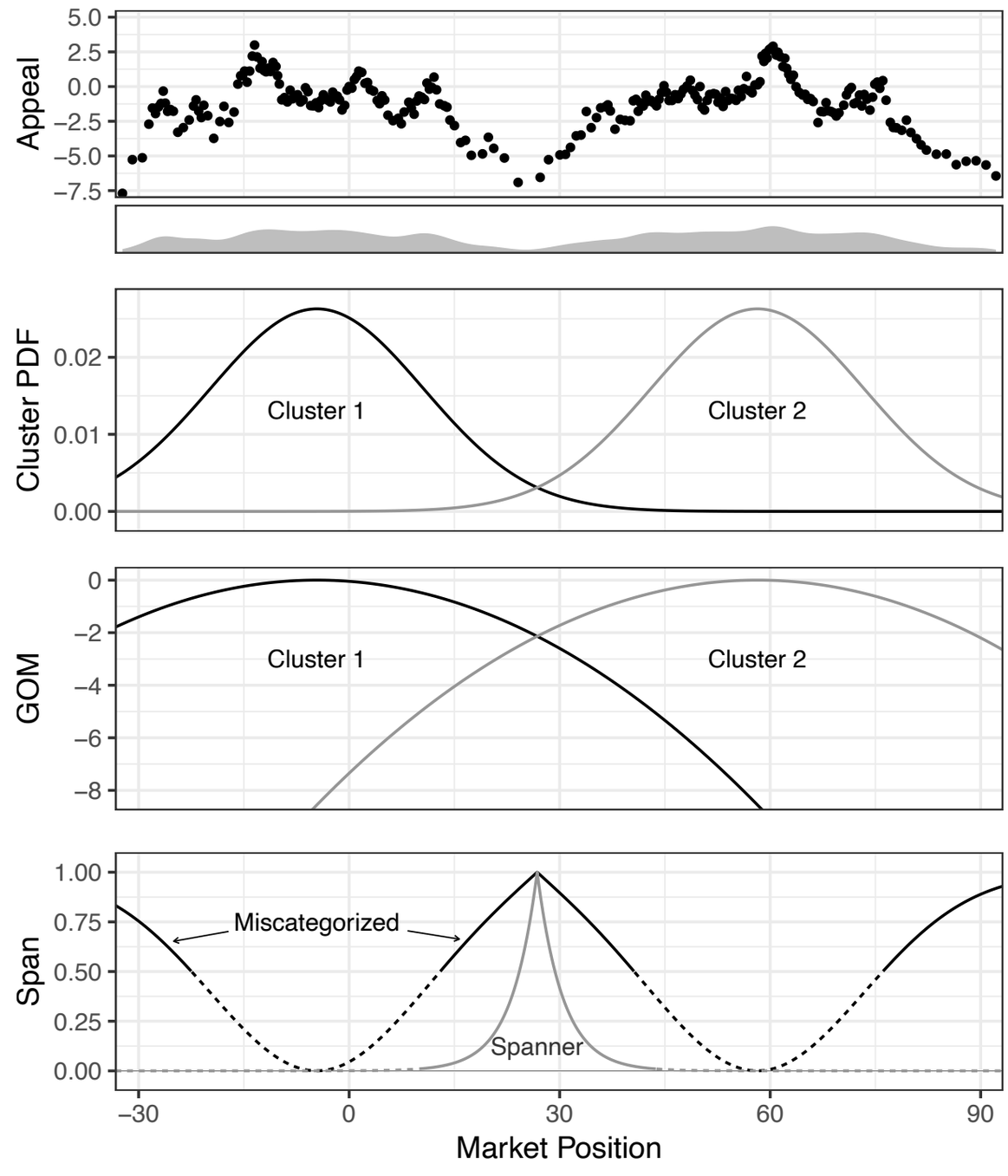
Measures of Categorization

- Miscategorized:

$$1 - \phi_{(1)}(x) - \phi_{(2)}(x)$$

- Spanner:

$$\phi_{(2)}(x) / \phi_{(1)}(x)$$



Measures of Categorization

- Miscategorized (binary):

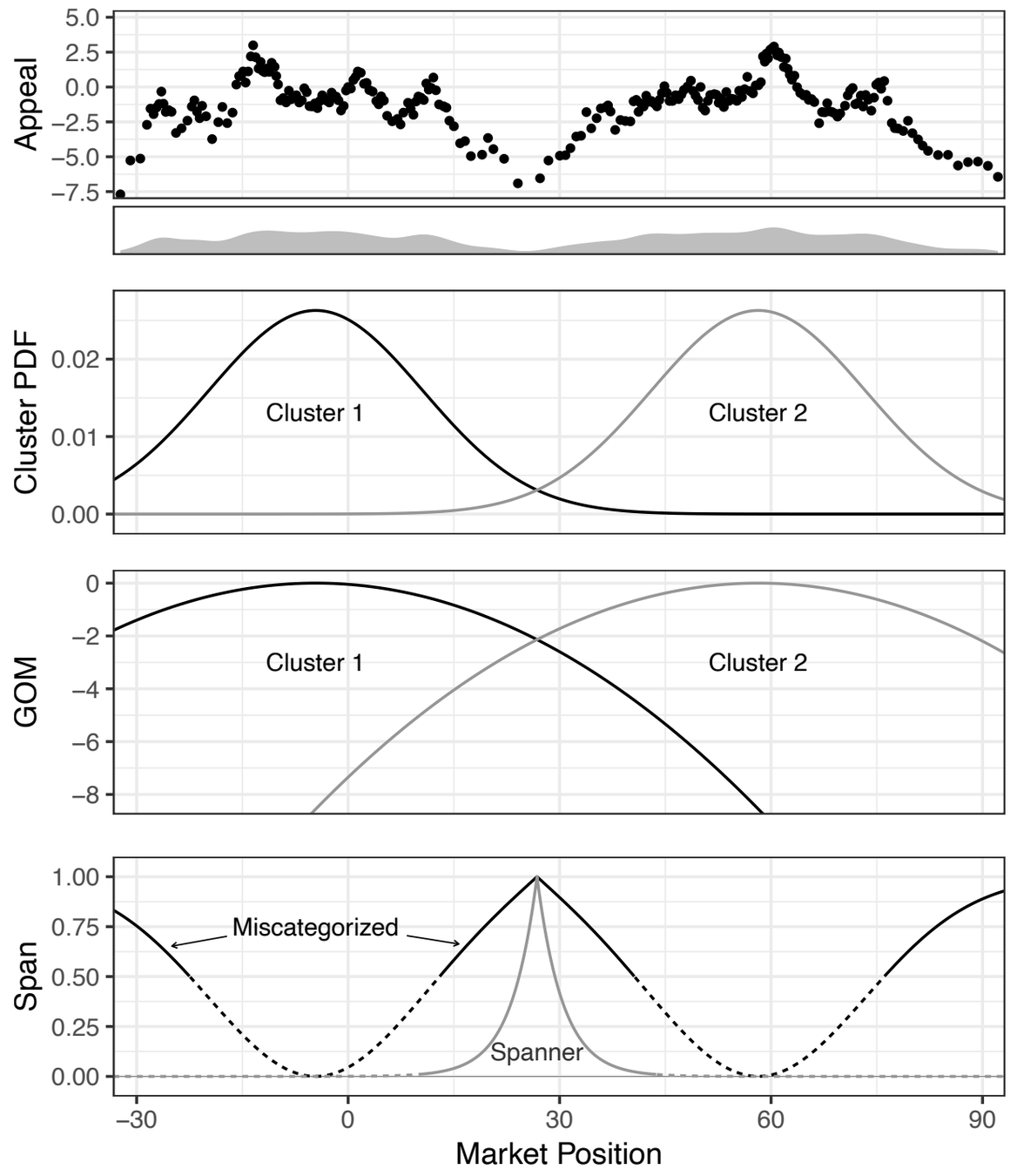
$$Miscat > \theta_1$$

- Spanner (binary):

$$(Miscat > \theta_1) \wedge (Span > \theta_2)$$

- Non-categorized (binary):

$$(Miscat > \theta_1) \wedge (Span \leq \theta_2)$$



Simulated Data

- 1000 markets, 250 periods
- DV: Producer Value
- Producer characteristics:
  - Market position
  - Isolation (Distance to nearest neighbor)
  - Prototypicality (GOM)
  - Miscategorization
    - Spanner/Non-categorized

Replicating and Extending Category Theory

1. "Miscategorization" penalty
2. Category movement
3. Category emergence

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Replicating "Miscategorization" Penalty

Within each market and period:

$$Value = \beta \cdot [Position]$$

Replicating "Miscategorization" Penalty

Within each market and period:

$$Value = \beta \cdot Miscategorization$$

Negative β = penalty

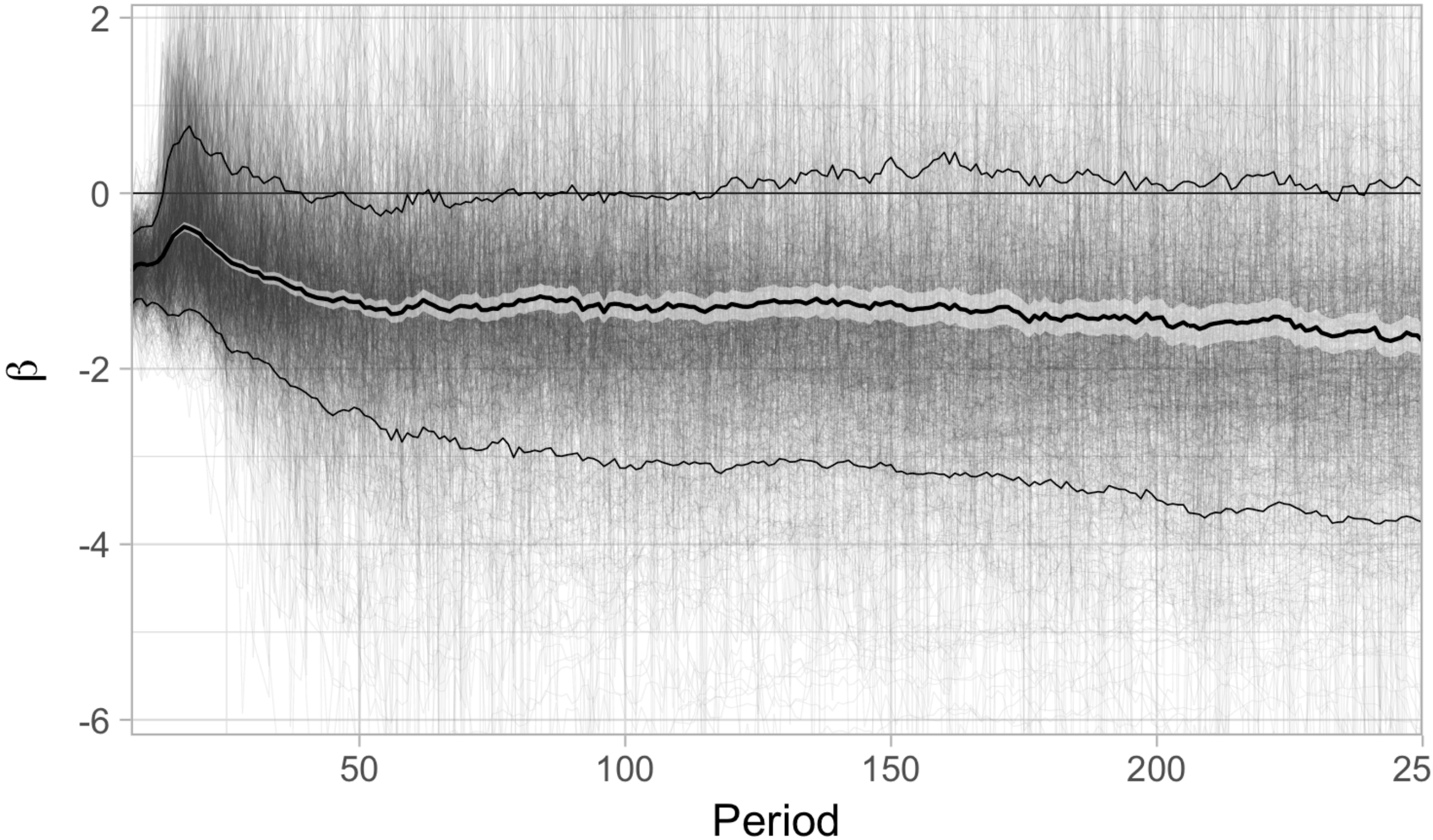
Replicating "Miscategorization" Penalty

Within each market and period:

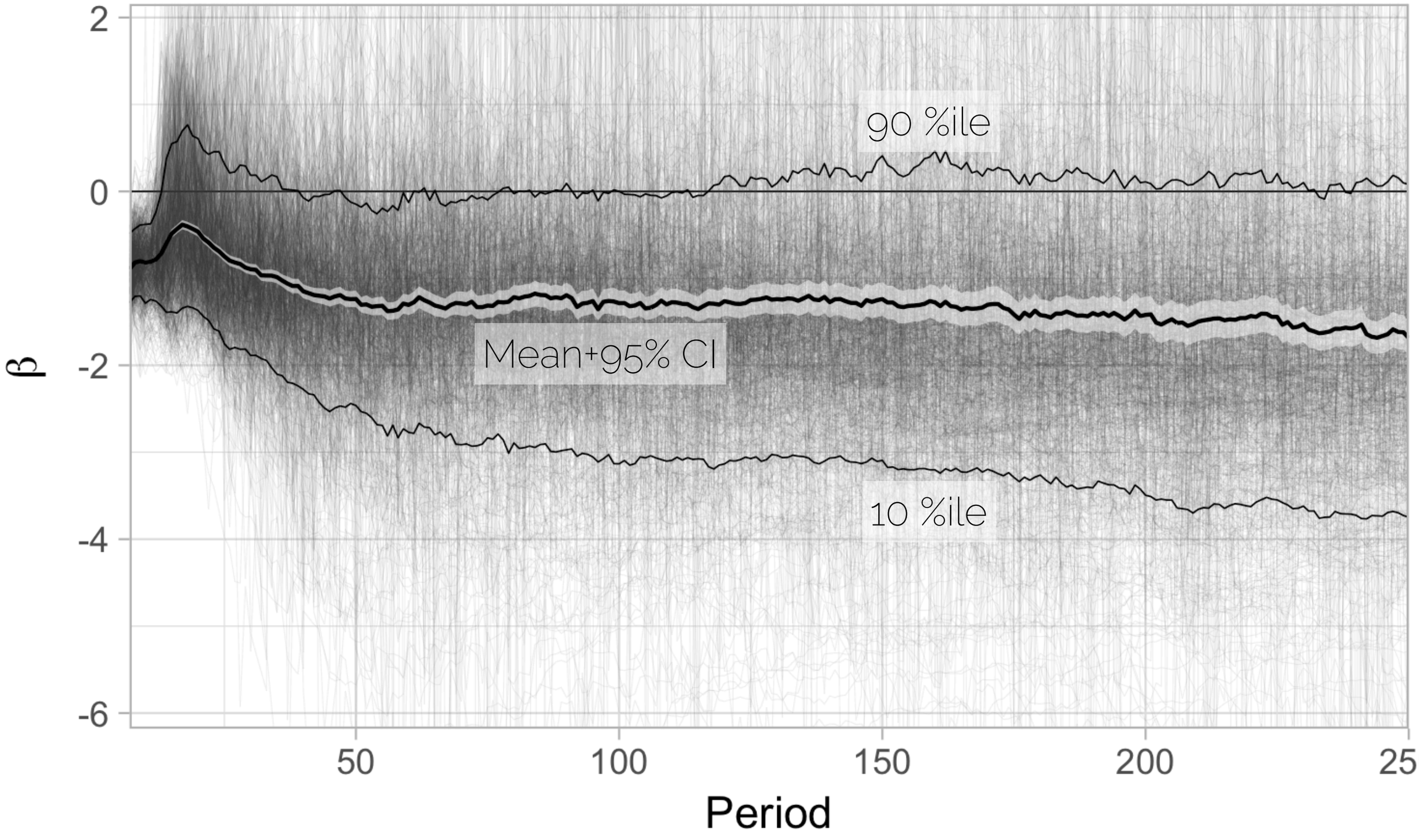
$$Value = \beta \cdot GOM$$

Positive β = penalty

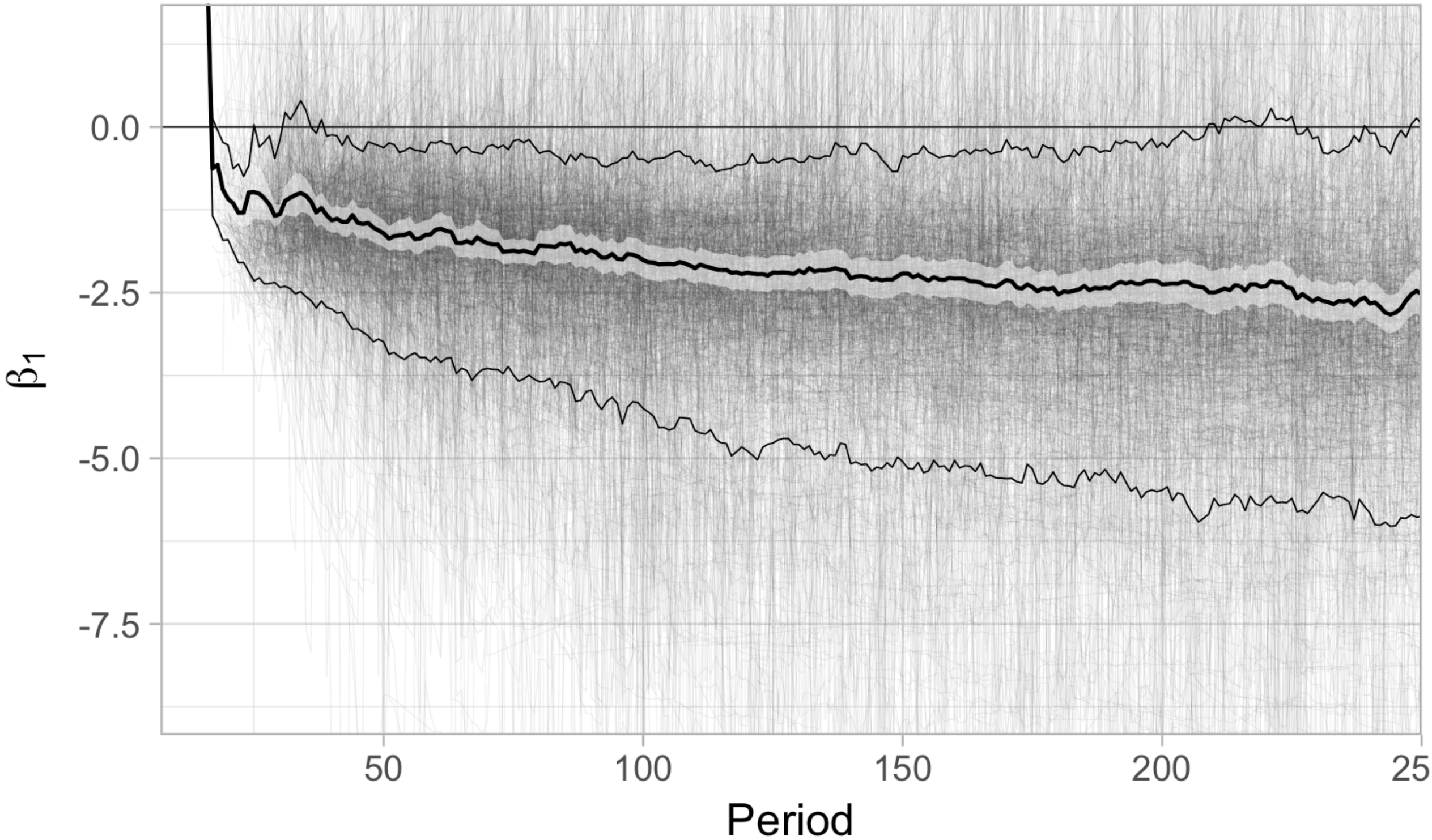
Penalty: Miscategorization



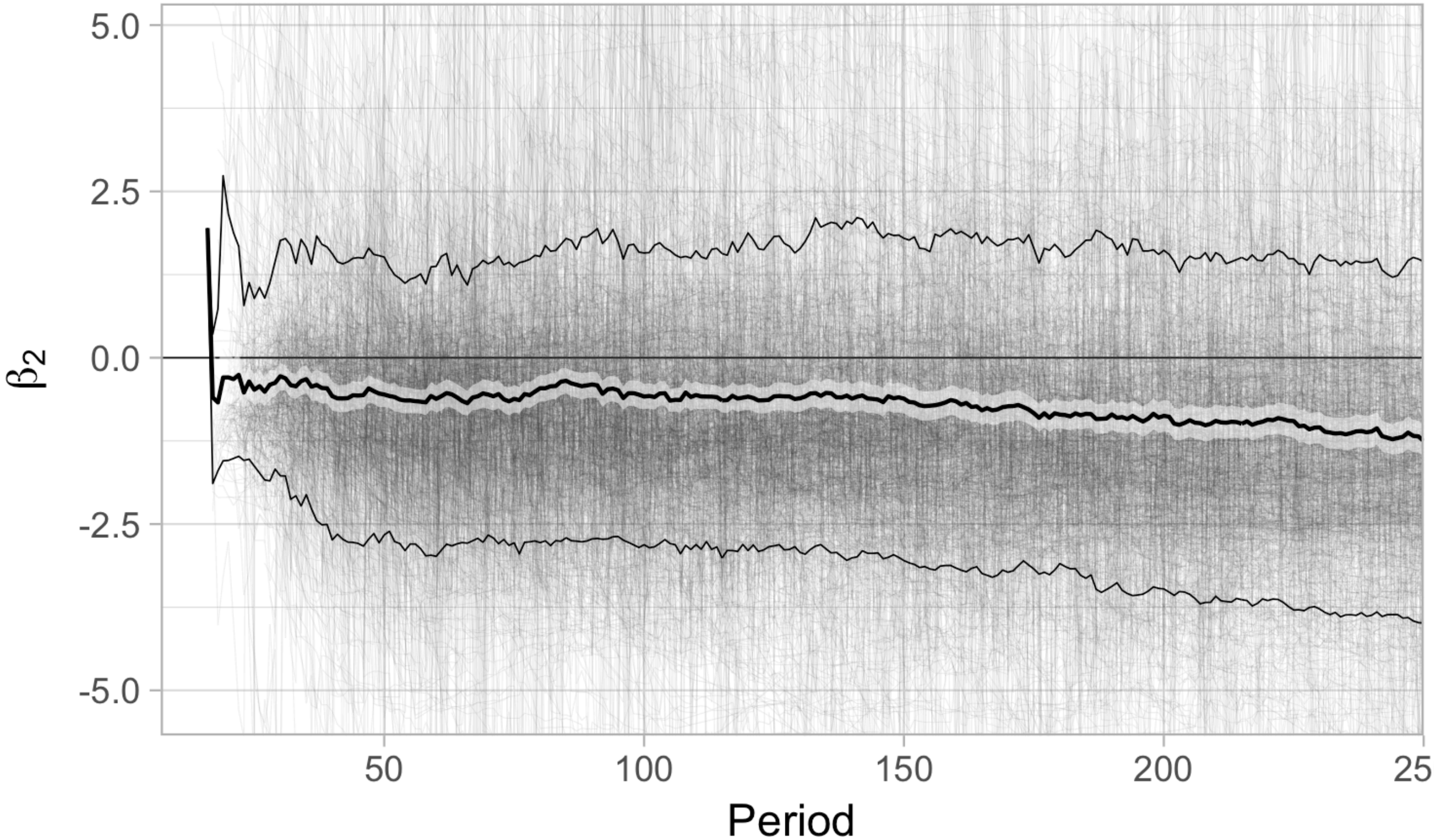
Penalty: Miscategorization



Penalty: No Category



Penalty: Spanner



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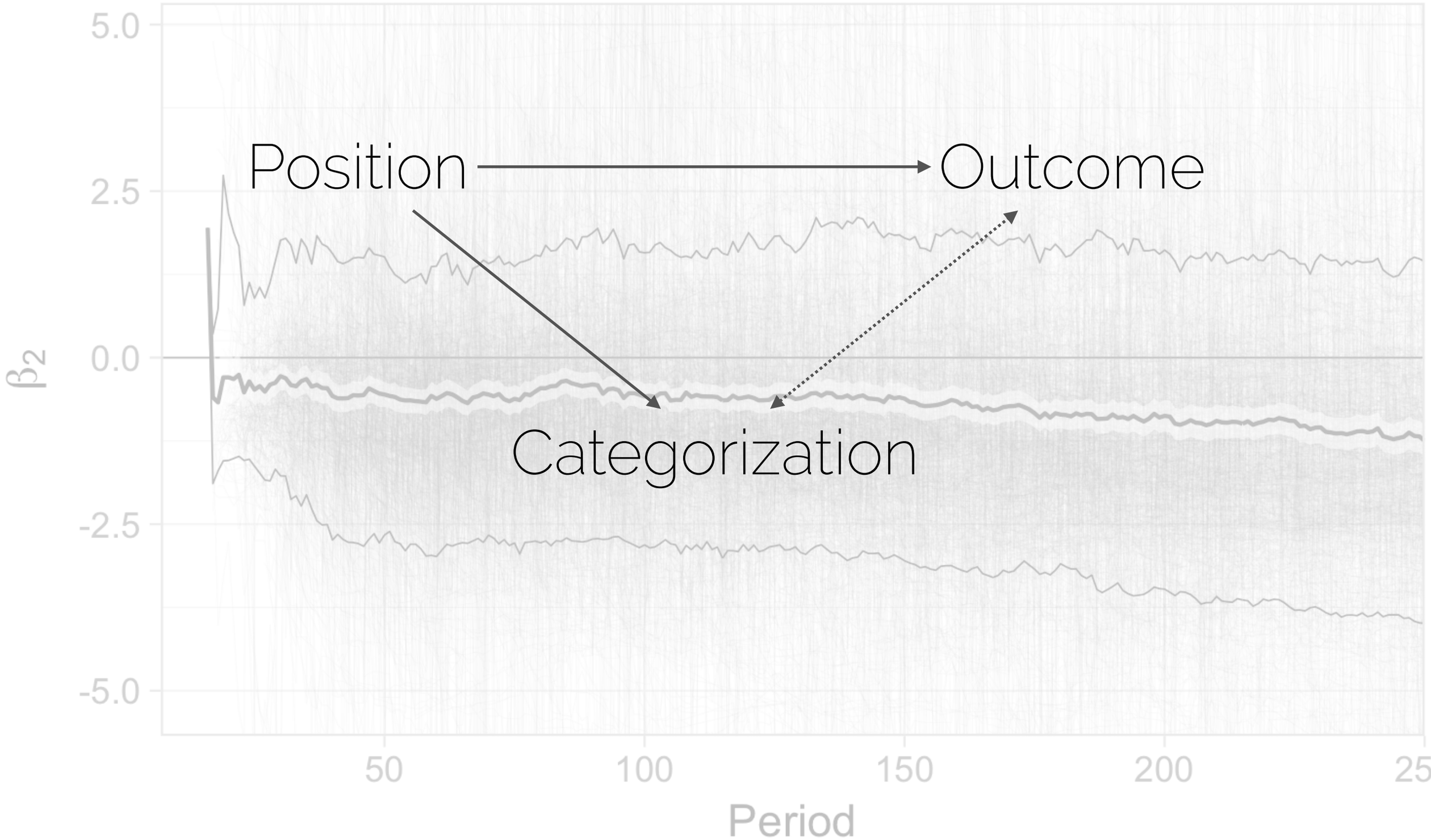
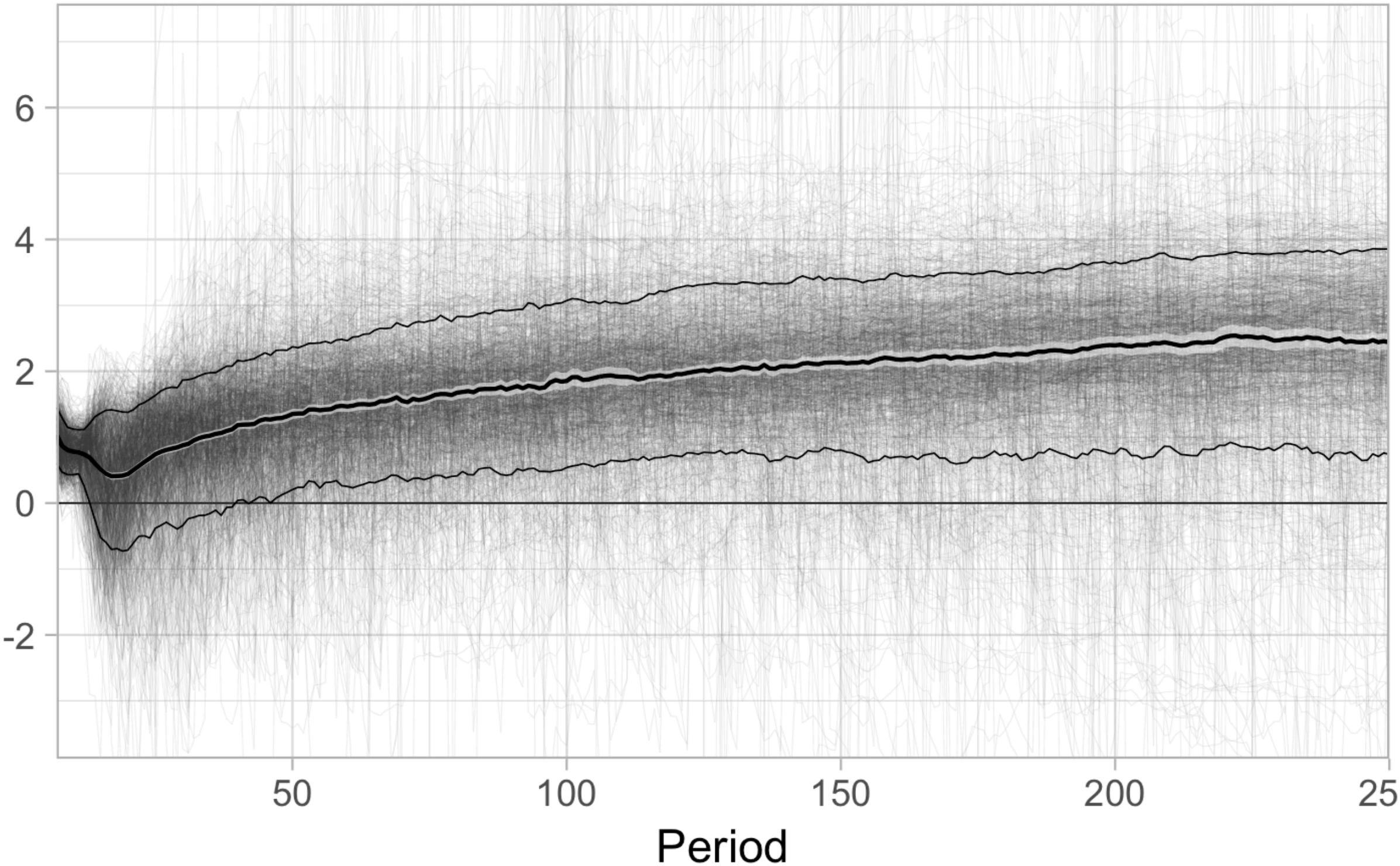


Bonus: GOM



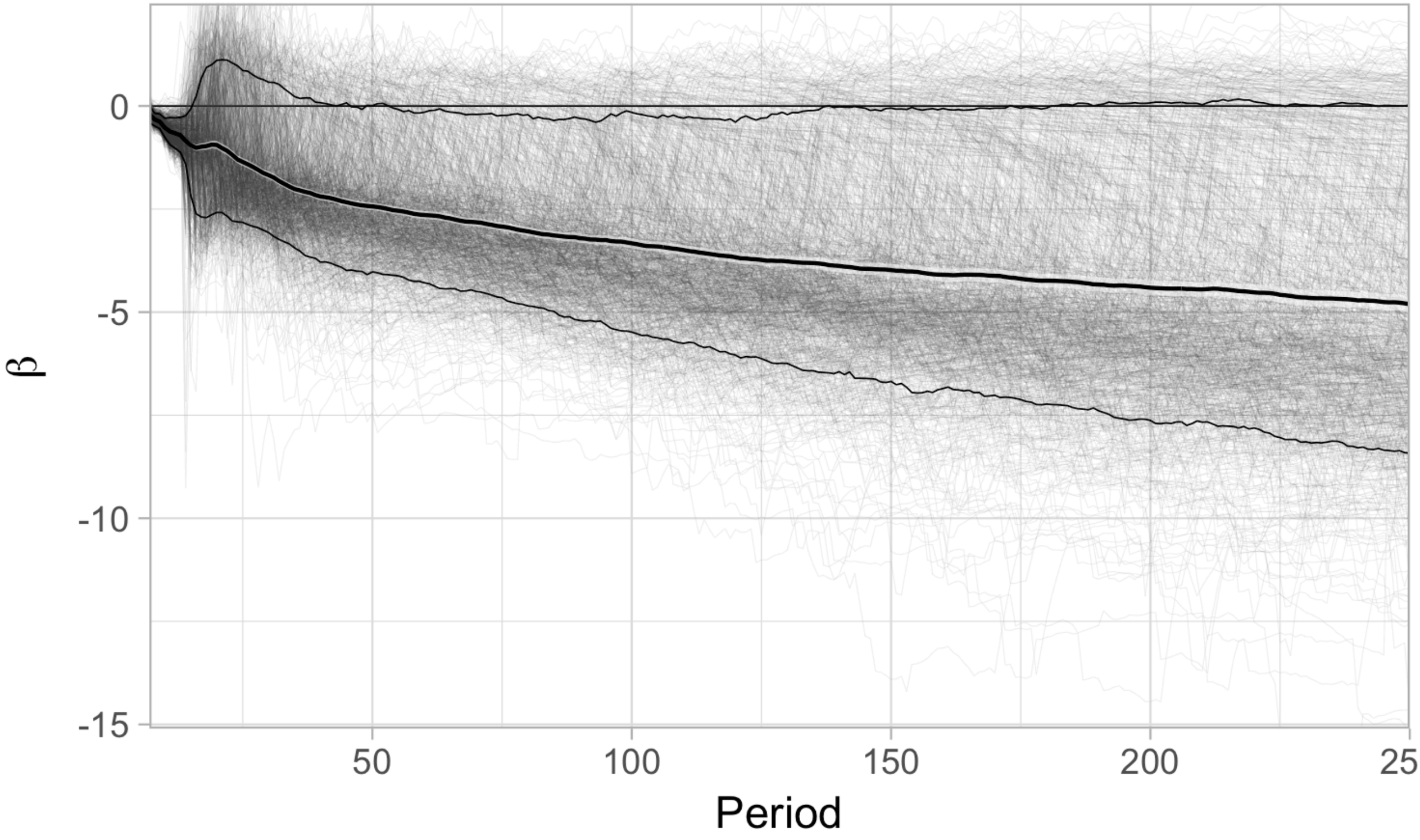
Penalty: Isolation

Within each market and period:

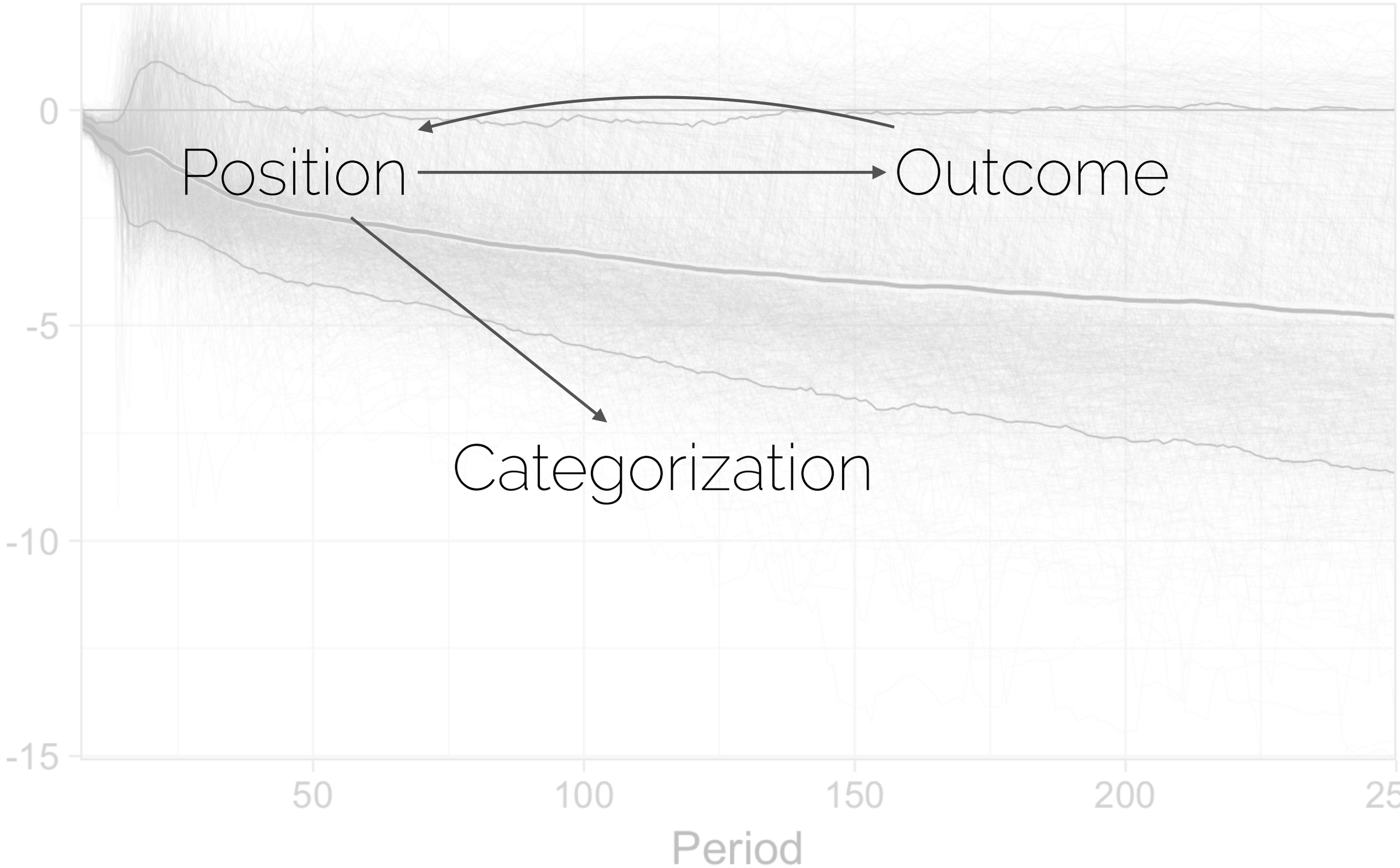
$$Value = \beta \cdot Isolation$$

Negative β = penalty

Penalty: Isolation



Penalty: Isolation



Replicating Category Theory

- Miscategorization penalty is a side effect of optimal exploration of uncertain terrain

Extending Category Theory

- Categories are cross-sectional
  - Change and move over time

Replicating and Extending Category Theory

1. "Miscategorization" penalty
2. Category movement
3. Category emergence

Replicating and Extending Category Theory

1. "Miscategorization" penalty
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Unexpected Success Attracts Categories

Entrant at new position

Fails

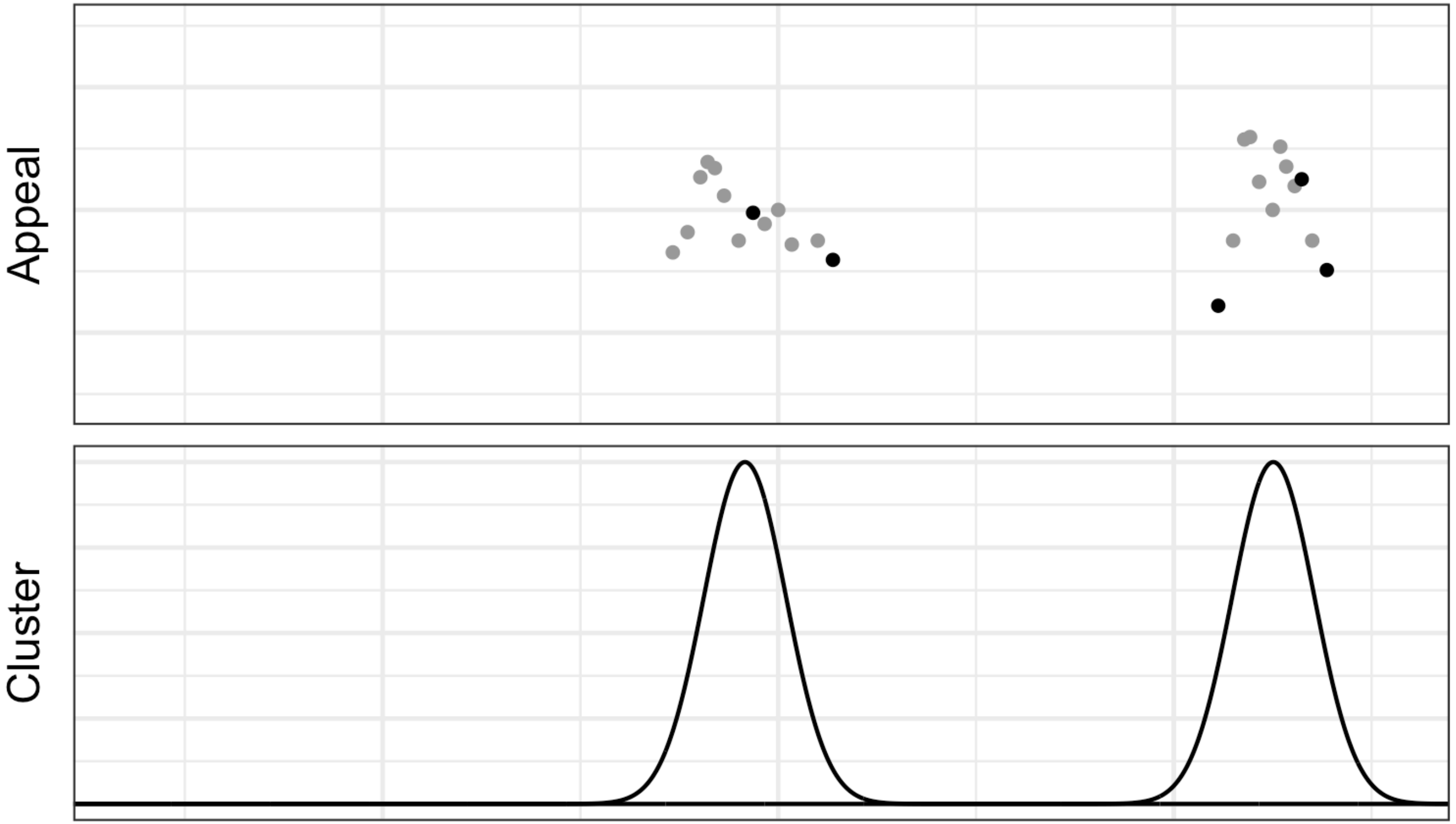
Later entrants **avoid**

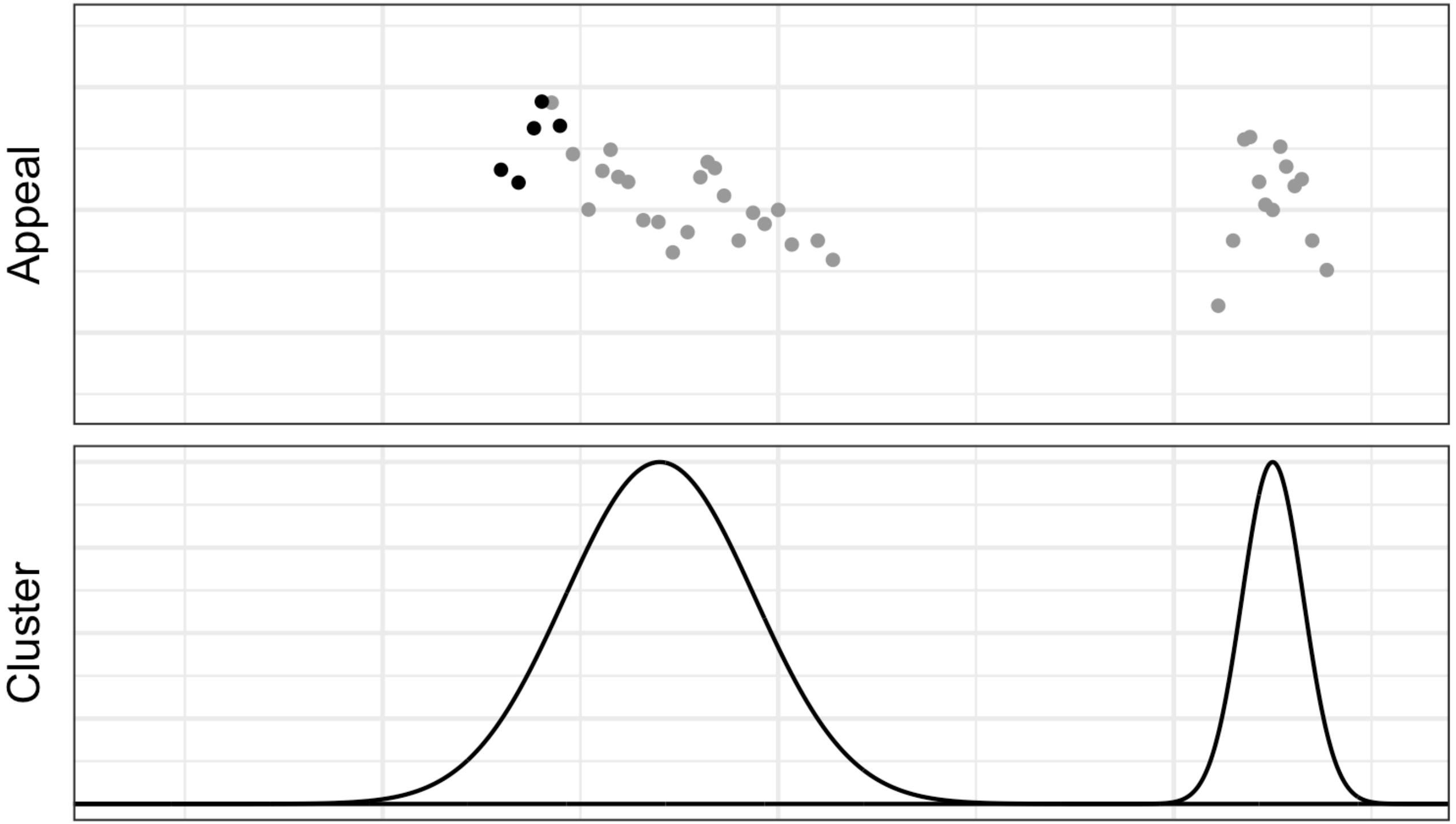
No net movement of categories

Succeeds

Later entrants **copy**

Net movement of categories


Appeal
Cluster
Position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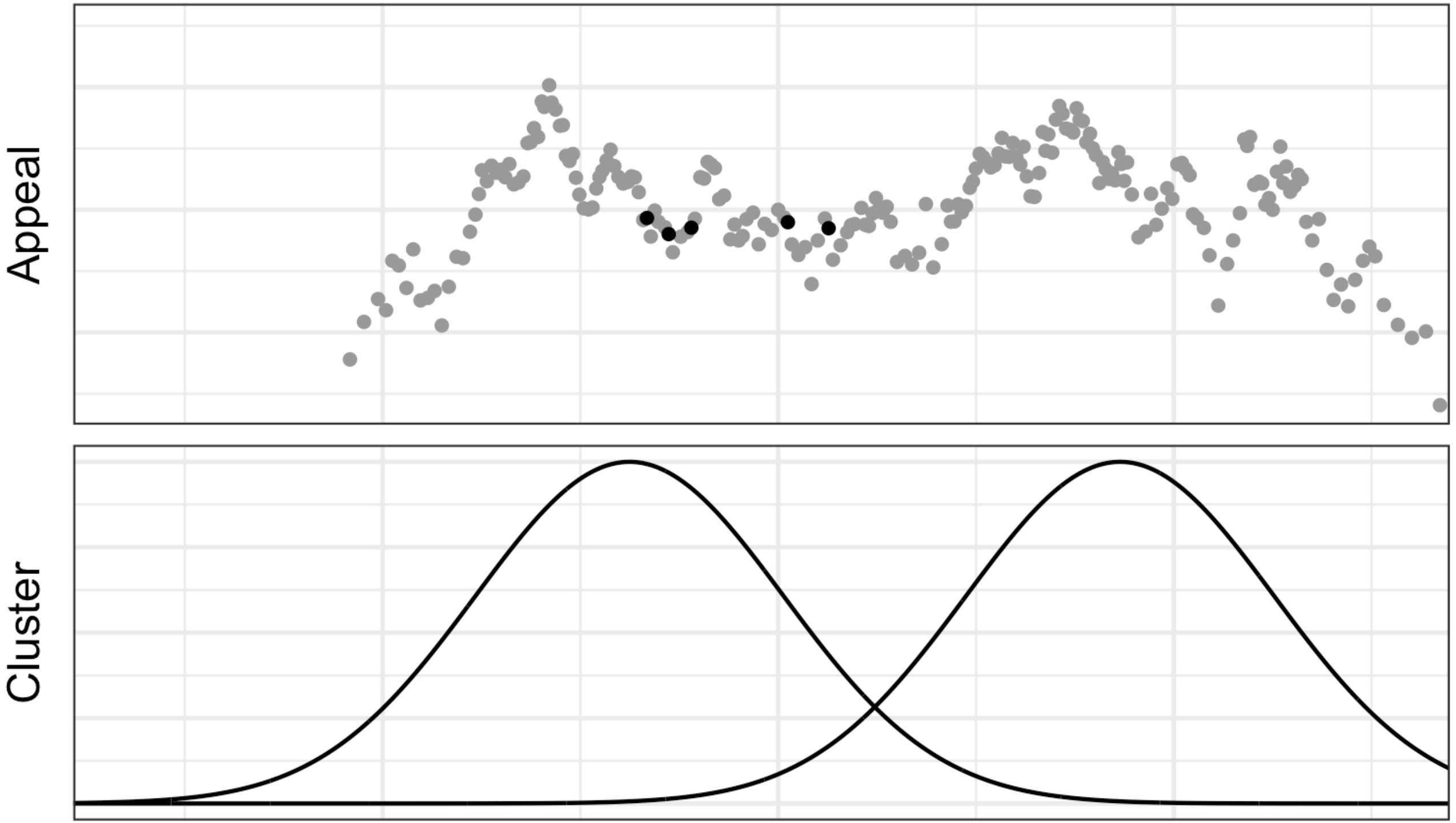

Appeal
Cluster
Position

Unexpected Success Attracts Categories

$$\Delta Value_T = Value_T - E_T(Value)$$

Unexpected Success Attracts Categories

$$[Position] \sim \Delta Value + \Delta Value \cdot Time + \ldots$$

Unexpected Success Attracts Categories

$$[Position] \sim \Delta Value + \Delta Value \cdot Time + \ldots$$

	GOM	10 Per.	25 Per.	Miscat.	10 Per.	25 Per.
ΔValue	0.091	0.078	0.115	-0.214	-0.132	-0.226
Time×**Δ**Value		0.010	0.001		-0.028	-0.004
Time		0.031	0.012		-0.069	-0.030
(Intercept)	-0.421	-0.772	-0.677	-0.840	-0.036	-0.232
Num. obs.	31354000	2674000	6154000	31354000	2674000	6154000

Unexpected Success Attracts Categories

- Categories migrate towards successful
- prototypical social network
- pitch by analogy, e.g. ‘Uber for dogs’
- exemplars, minivans, vanguard influence

Replicating and Extending Category Theory

1. "Miscategorization" penalty
2. Category movement
3. Category emergence

Penalty Trend Predicts Categorical Change

$$Value = \beta_t \cdot GOM$$

Larger $\boldsymbol{\beta}$ = Stronger Penalty

Penalty Trend Predicts Categorical Change

$$\Delta\beta_{GOM} = \beta_t - \beta_{t-25}$$

Positive $\boldsymbol{\Delta\beta}$ = Increasingly Strong Penalty

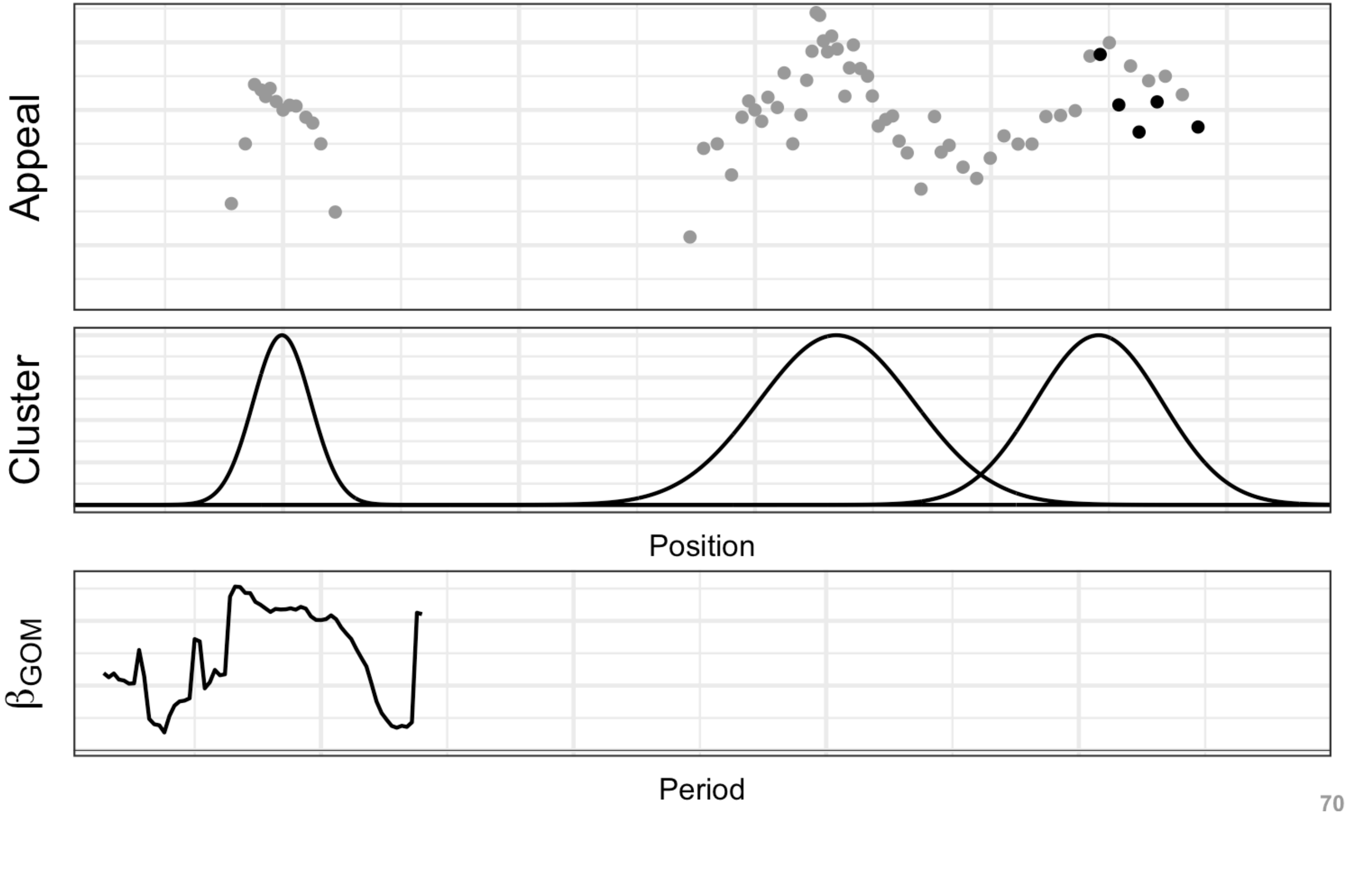
Appeal

Cluster

Position

β_{GOM}

Period


Appeal
Cluster
Position
β_{GOM}
Period

Penalty Trend Predicts Categorical Change

- Categories can merge or emerge
  - Successful spanners can combine multiple categories into one
  - Successful innovators can discover new categories
- Predicting probability of any future change

Penalty Trend Predicts Categorical Change

$$\Delta Categories \sim \Delta \beta_{[Position]}$$

Weakening Penalty Predicts Categorical Change

$$\Delta Categories \sim \Delta \beta_{[Position]}$$

	(1)	(2)	(3)	(4)	(5)
Penalty Trend (Isolation)	-1.720				
Penalty Trend (GOM)		-1.464			
Penalty Trend (No Cat.)			-0.515		-0.466
Penalty Trend (Spanner)				-0.440	-0.307
(Intercept)	-2.840	-2.855	-2.968	-2.970	-2.969
Num. obs.	219000	219000	151837	151837	151837

Weakening Penalty Predicts Categorical Change

- Miscategorization penalty is retrospective prediction of market value
- e.g.
  - market makers
  - haute cuisine

Replicating and Extending Category Theory

1. "Miscategorization" penalty
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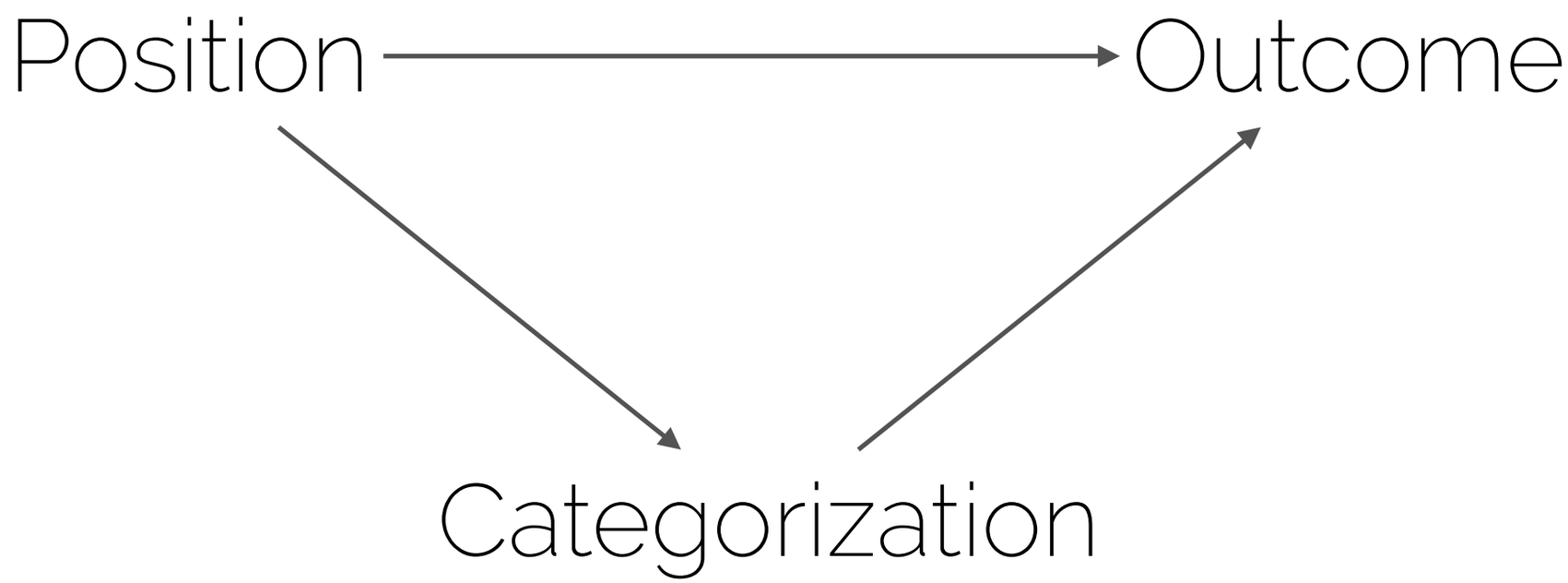
3. Category emergence

Discussion

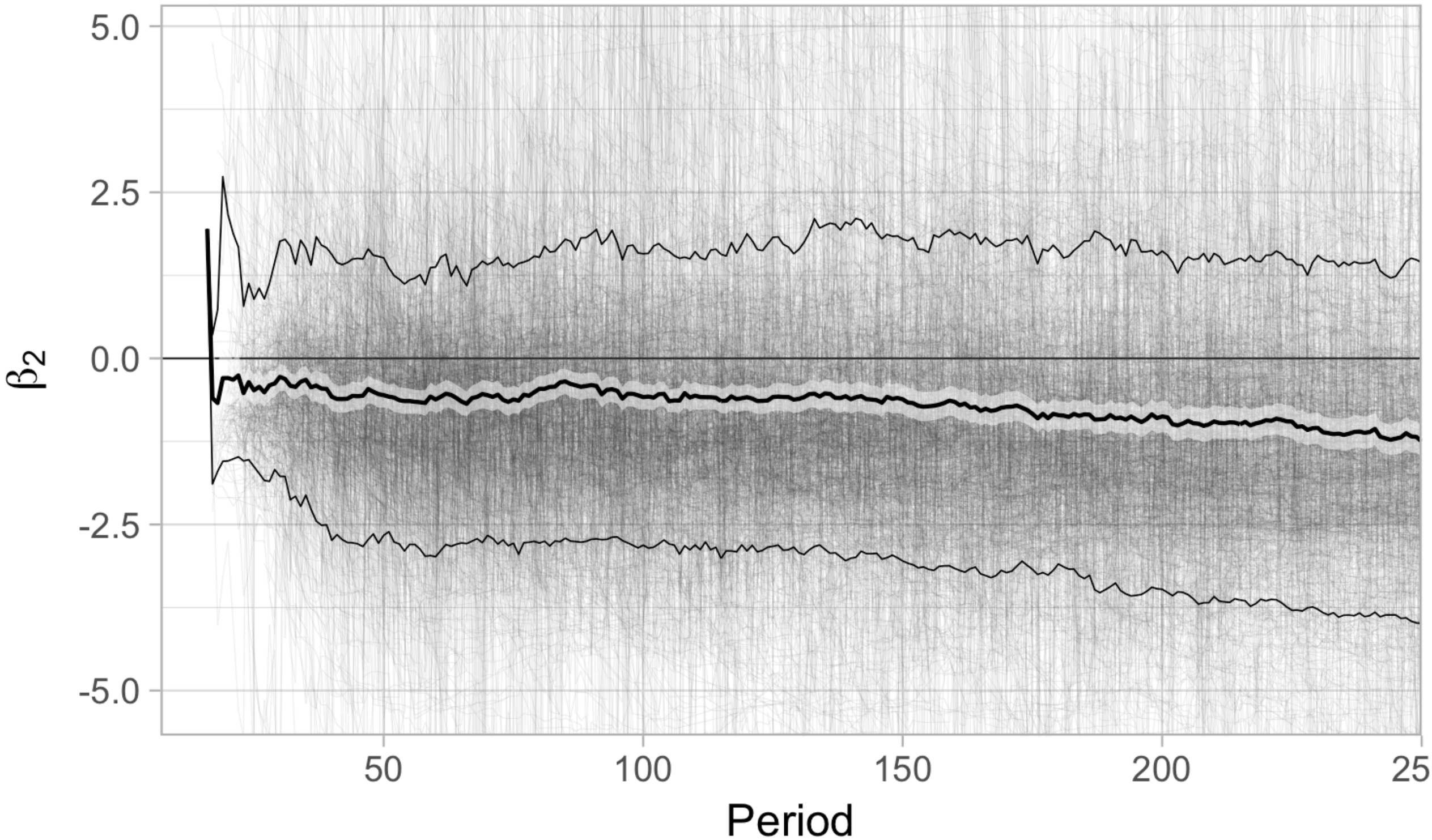
Discussion

- Producer knowledge vs audience knowledge of world

Discussion



Discussion



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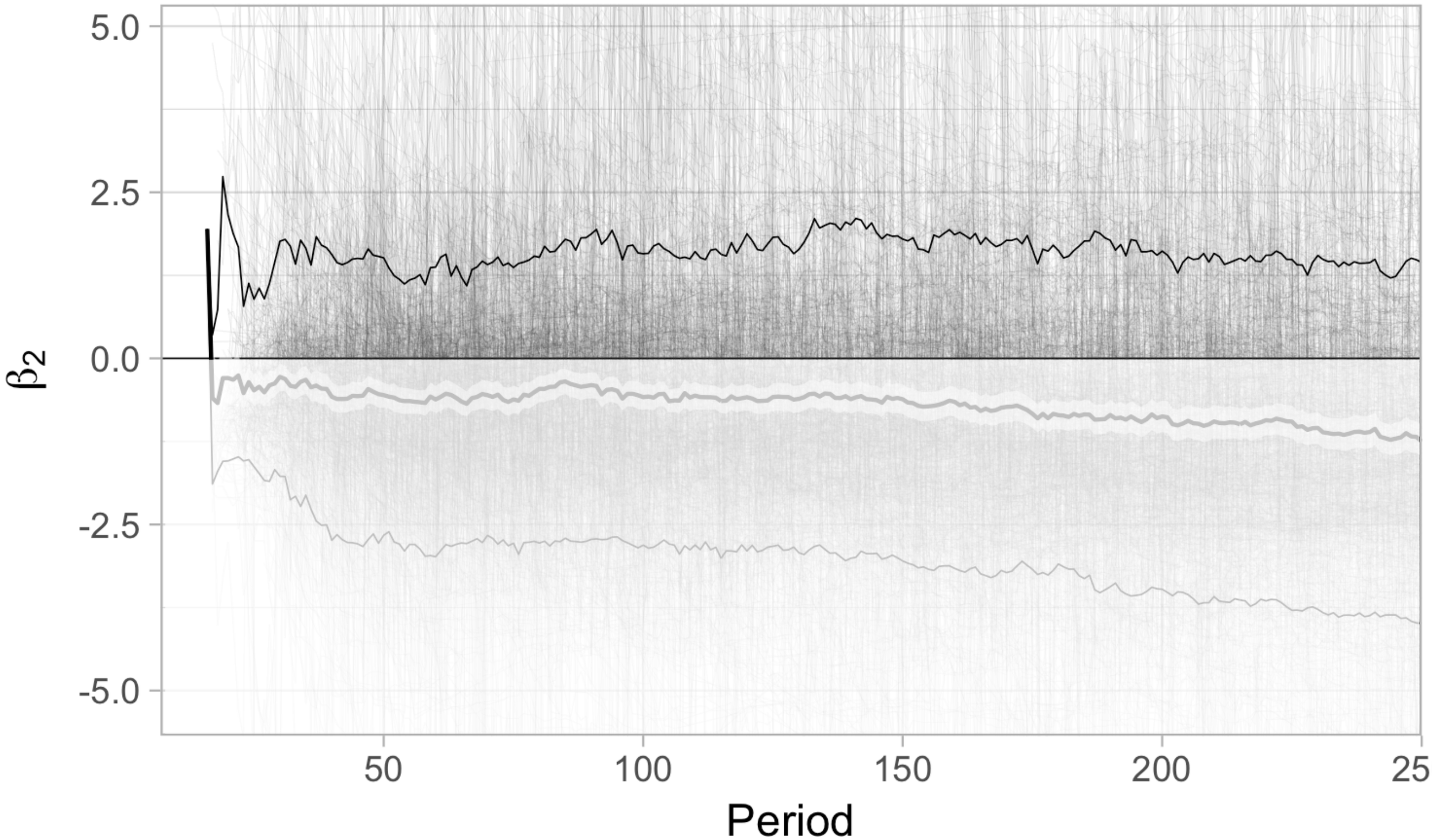
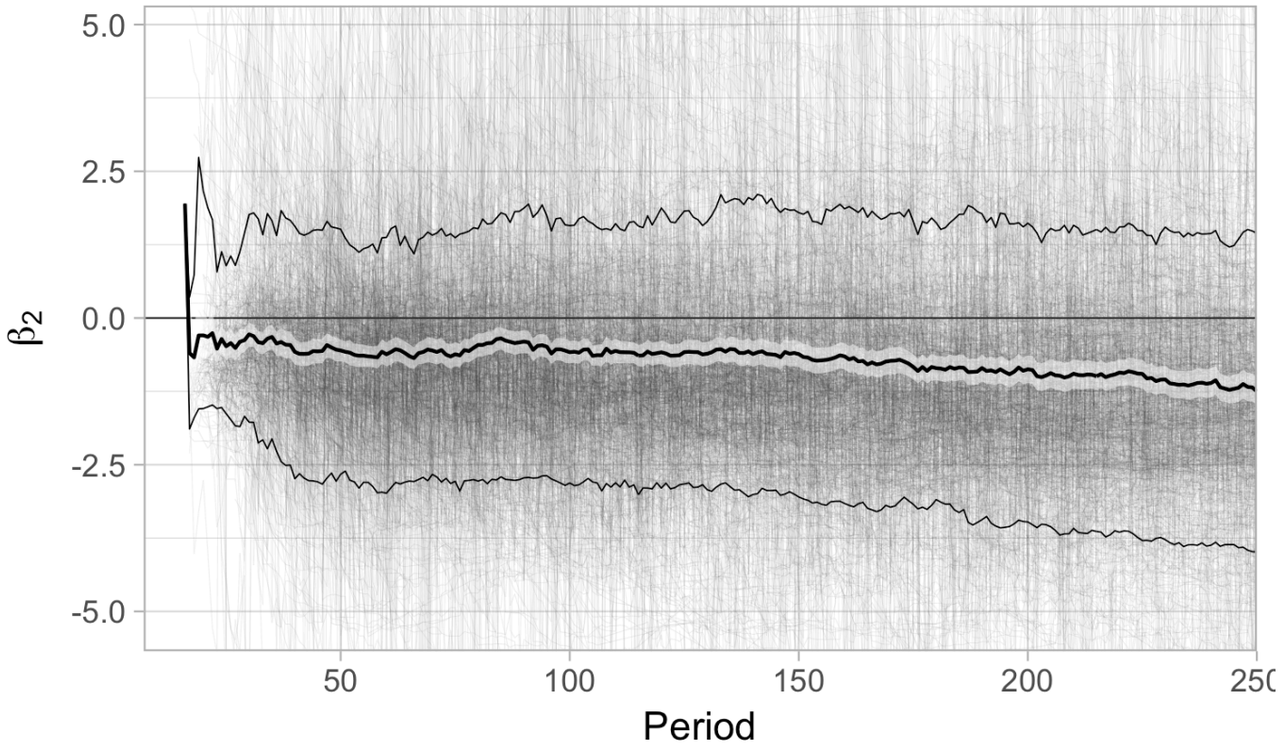
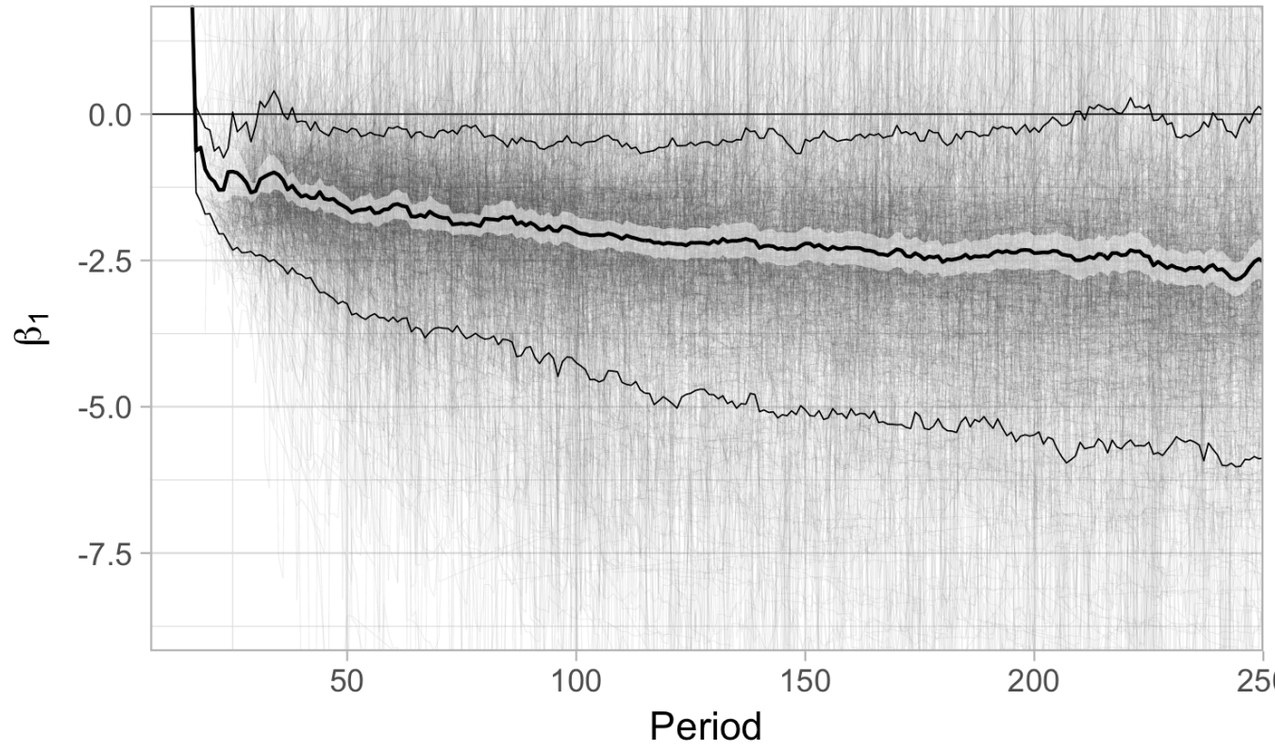


Discussion



Spanner



No Category

Thanks!