Package 'fuzzyurn'

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Type Package

Title Generalized Non-Central Fuzzy Dynamic Hypergeometric Processes

Version 0.1.0

Description Implements Generalized Non-Central Fuzzy Dynamic Hypergeometric Processes. Includes discrete Markov chain sampling under dynamic weight decay and continuous fuzzy membership maps, infinitesimal generator evaluation, weak convergence to Itô diffusion SDEs, numerical solutions for Fokker-Planck PDEs, stationary Gibbs-Boltzmann densities, and Azuma-Hoeffding concentration bounds.

License GPL (>= 3)

Encoding UTF-8

Imports stats

Suggests deSolve, graphics, testthat (>= 3.0.0)

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NeedsCompilation no

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fuzzyurn_bound *Non-Asymptotic Azuma-Hoeffding Concentration Bound*

Description

Computes tail upper bound P(|X_n - E[X_n]| >= epsilon).

Usage

```
fuzzyurn_bound(epsilon, n, M_mu = 1)
```

Arguments

epsilon	Numeric. Deviation threshold.
n	Integer. Sample draw size.
M_mu	Numeric. Upper bound on fuzzy membership measure. Default is 1.0.

Value

Upper bound probability value.

fuzzyurn_generator *Infinitesimal Generator, Drift, and Diffusion Functions*

Description

Computes discrete drift b_N(y, tau) and diffusion a_N(y, tau) operators.

Usage

```
fuzzyurn_generator(y, weights, mu_unobserved)
```

Arguments

y	Numeric. Scaled fuzzy state y in [0, 1].
weights	Vector. Unobserved element weights.
mu_unobserved	Vector. Fuzzy membership values for unobserved elements.

Value

List containing drift ‘b‘ and diffusion ‘a‘.

fuzzyurn_sde *Diffusion Limit SDE Simulator*

Description

Simulates continuous Itô Diffusion Limit process dY(tau).

Usage

```
fuzzyurn_sde(N, y0, T_max = 1, steps = 1000, drift_fn, diff_fn)
```

Arguments

N	Integer. Total population size.
y0	Numeric. Initial state y(0).
T_max	Numeric. Time horizon.
steps	Integer. Number of Euler-Maruyama discretization steps.
drift_fn	Function b(y, tau).
diff_fn	Function a(y, tau).

Value

Data frame with time ‘tau‘ and continuous trajectory ‘Y‘.

fuzzyurn_stationary *Stationary Invariant Gibbs-Boltzmann Density*

Description

Computes exact invariant potential landscape density p_infinity(y).

Usage

```
fuzzyurn_stationary(y_grid, N, drift_fn, diff_fn)
```

Arguments

y_grid	Vector. Discretized grid on [0, 1].
N	Integer. Population size.
drift_fn	Function b(y).
diff_fn	Function a(y).

Value

Vector of normalized density values over ‘y_grid‘.

rfuzzyurn *Generalized Non-Central Fuzzy Dynamic Sampling*

Description

Simulates discrete trajectory of fuzzy success accumulation under dynamic state-dependent weights.

Usage

```
rfuzzyurn(n, Z, mu, w0, gamma_kernel = NULL, delta = NULL)
```

Arguments

n	Integer. Number of draws (sample size).
Z	Matrix. Latent feature matrix (N x d) for finite population universe.
mu	Function or Vector. Fuzzy membership mapping mu(z) in [0, 1].
w0	Function or Vector. Baseline intrinsic attraction weights w0(z) > 0.
gamma_kernel	Function. Symmetric interaction kernel gamma(z_i, z_j).
delta	Vector or Matrix. Depletion/decay rates delta_i(t).

Value

List containing selected indices, trajectory of fuzzy mass X_t, and final mass.

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