# README: Simulation Scripts Overview

## Overview

This directory contains R scripts used for simulating and evaluating graphon-based transfer learning under various scenarios, including varying sample size, structural perturbation (lambda), threshold selection strategies, and ablation studies.

## Contents

Below is a brief description of each R script included in the folder:

* function.R

Defines core functions used for graphon estimation, transport, and debiasing in transfer learning.

* auxiliary.R

Provides internal utility functions used across the simulation workflow:

- is.Adj, is.binAdj, and is.binAdjvec validate adjacency matrices.- sum3 performs tensor summation over a list of graphs.- histogram3D computes a 3D histogram over a graph collection based on cluster assignments.- aux\_nbdsmooth constructs a dissimilarity matrix from squared adjacency matrix products, used for smoothing.

* increasingN\_MSE.R

Simulates how Mean Squared Error (MSE) varies with increasing source sample size.

* varyingLambda\_MSE.R

Examines how MSE is affected by varying levels of perturbation (lambda) in the source graphon.

* network\_generate.R

Generates synthetic graphons and corresponding adjacency matrices for simulation.

* ICE.R

Implementation of the ICE (Iterative Connecting Probability Estimator) baseline method for comparison.

* threshold\_delta.R

Implements edge-based cross-validation to select optimal threshold delta (debiasing trigger).

* threshold\_epsilon.R

Selects the best entropic GW regularization parameter epsilon through performance-based tuning.

* cross\_graphon\_trans.R

Evaluates transferability across graphons by testing all source-target graphon pairs.

* varyingLambda\_ablation.R

Performs ablation studies under varying lambda to isolate debiasing contributions.

* increasingN\_ablation.R

Ablation study evaluating robustness of methods as sample size increases.

## Usage

Make sure the required R packages (e.g., `reticulate`, `pheatmap`, `parallel`) are installed.