# Package 'SpPOP'

January 20, 2025

**Type** Package

**Title** Generation of Spatial Population under Different Levels of
Relationships among Variables

**Version** 0.1.0

**Author** Nobin Chandra Paul, Anil Rai, Ankur Biswas, Tauqueer Ahmad and Prachi Misra Sahoo

**Maintainer** Nobin Chandra Paul<nobin.niasm@outlook.com>

**Description** The developed package can be used to generate a spatial population for different
levels of relationships among the dependent and auxiliary variables along with spatially
varying model parameters. A spatial layout is designed as a [0,k-1]x[0,k-
1] square region on which observations
are collected at (k x k) lattice points with a unit distance between any two neighbour-
ing points along the horizontal
and vertical axes. For method details see Chao, Liu., Chuanhua, Wei. and Yu-
nan, Su. (2018).<doi:10.1080/10485252.2018.1499907>.
The generated spatial population can be utilized in Geographically Weighted Regres-
sion model based analysis for studying the
spatially varying relationships among the variables. Furthermore, various statistical analy-
sis can be performed on this spatially
generated data.

**Imports** stats, qpdf, numbers

**License** GPL (>= 2.0)

**Encoding** UTF-8

**RoxygenNote** 7.2.3

**Suggests** rmarkdown, knitr

**VignetteBuilder** knitr

**NeedsCompilation** no

**Repository** CRAN

**Date/Publication** 2023-04-24 10:00:10 UTC

# Contents

---

| SpPOP_linear1 | *Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes* |
|---|---|

---

## Description

Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes

## Usage

```
SpPOP_linear1(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X). The auxiliary variable has been generated following U(0,1) and the regression coefficients are generated as linear function of latitudes and longitudes.

**References**

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

**Examples**

```
sp_linear1<-SpPOP_linear1(100,10,c(1:10),c(1:10))
```

---

| | |
|---|---|
| SpPOP_linear2 | *Generation of spatial population includes multiple auxiliary variables along with spatially varying model parameters generated based on linear function of latitudes and longitudes* |

---

**Description**

Generation of spatial population includes multiple auxiliary variables along with spatially varying model parameters generated based on linear function of latitudes and longitudes

**Usage**

```
SpPOP_linear2(N, k, xlat, ylong)
```

**Arguments**

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

**Value**

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and three explanatory variables (i.e. X1, X2, and X3). The auxiliary variables have been generated independently from uniform distribution U(0,1) and the regression coefficients are generated as linear function of latitudes and longitudes.

**References**

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_linear2<-SpPOP_linear2(100,10,c(1:10),c(1:10))
```

---

| SpPOP_linear3 | *Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes* |
|---|---|

---

## Description

Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes

## Usage

```
SpPOP_linear3(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X). The auxiliary variable has been generated following $U(0,2)$ and the regression coefficients are generated as linear function of locations.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_linear3<-SpPOP_linear3(100,10,c(1:10),c(1:10))
```

| SpPOP_linear4 | *Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes* |
|---|---|

## Description

Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes

## Usage

```
SpPOP_linear4(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X). The auxiliary variable has been generated following U(0,2) and the regression coefficients are generated as linear function of locations.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_linear4<-SpPOP_linear4(100,10,c(1:10),c(1:10))
```

| SpPOP_linear5 | *Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes* |
|---|---|

## Description

Generation of spatial population along with spatially varying model parameters generated based on linear function of latitudes and longitudes

## Usage

```
SpPOP_linear5(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and two explanatory variables (i.e. X1 and X2). The auxiliary variables are independently drawn from the uniform distribution U(0,2) and normal distribution N(1,1) and the regression coefficients are generated as linear function of locations.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_linear5<-SpPOP_linear5(100,10,c(1:10),c(1:10))
```

---

| | |
|---|---|
| SpPOP_nonlinear1 | *Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes* |

---

## Description

Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes

## Usage

```
SpPOP_nonlinear1(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X). The auxiliary variable has been generated following U(0,1) and the regression coefficients are generated as non-linear function of latitudes and longitudes.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_nonlinear1<-SpPOP_nonlinear1(100,10,c(1:10),c(1:10))
```

---

SpPOP_nonlinear2              *Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes*

---

## Description

Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes

## Usage

```
SpPOP_nonlinear2(N, k, xlat, ylong)
```

## Arguments

N                  integer; population size i.e. N= (k * k)

k                  integer

xlat               numeric vector

ylong              numeric vector

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X). The auxiliary variable has been generated following U(0,1) and the regression coefficients are generated as non-linear function of latitudes and longitudes.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_nonlinear2<-SpPOP_nonlinear2(100,10,c(1:10),c(1:10))
```

---

| | |
|---|---|
| SpPOP_nonlinear3 | *Generation of spatial population includes multiple auxiliary variables along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes* |

---

## Description

Generation of spatial population includes multiple auxiliary variables along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes

## Usage

```
SpPOP_nonlinear3(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X1, X2, and X3). The auxiliary variables has been generated independently from uniform distribution U(0,1) and the regression coefficients are generated as non-linear function of latitudes and longitudes.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_nonlinear3<-SpPOP_nonlinear3(100,10,c(1:10),c(1:10))
```

---

| SpPOP_nonlinear4 | *Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes* |
| --- | --- |

---

## Description

Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes

## Usage

```
SpPOP_nonlinear4(N, k, xlat, ylong)
```

## Arguments

| | |
| --- | --- |
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and one explanatory variable (i.e. X). The auxiliary variable has been generated following U(0,2) and the regression coefficients are generated as non-linear function of latitudes and longitudes.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_nonlinear4<-SpPOP_nonlinear4(100,10,c(1:10),c(1:10))
```

---

| | |
|---|---|
| SpPOP_nonlinear5 | *Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes* |

---

## Description

Generation of spatial population along with spatially varying model parameters generated based on non-linear function of latitudes and longitudes

## Usage

```
SpPOP_nonlinear5(N, k, xlat, ylong)
```

## Arguments

| | |
|---|---|
| N | integer; population size i.e. N= (k * k) |
| k | integer |
| xlat | numeric vector |
| ylong | numeric vector |

## Value

The developed function returns a dataframe of spatially generated population consist of simulated response variable (i.e. Y) along with their spatial coordinates, spatially varying coefficients and two explanatory variables (i.e. X1 and X2). The auxiliary variables are drawn independently from uniform distribution $U(0,2)$ and normal distribution $N(1,1)$ and the regression coefficients are generated as non-linear function of latitudes and longitudes.

## References

1. Wang, Ning., Mei, Chang-Lin. and Yan, Xiao-Dong. (2008). Local Linear Estimation of Spatially Varying Coefficient Models: An Improvement on the Geographically Weighted Regression Technique. Environment and Planning A: Economy and Space, 40(4), 986-1005.<DOI:10.1068/a3941>.

2. Chao, Liu., Chuanhua, Wei. and Yunan, Su. (2018). Geographically weighted regression model-assisted estimation in survey sampling. Journal of Nonparametric Statistics. <DOI:10.1080/10485252.2018.1499907>.

## Examples

```
sp_nonlinear5<-SpPOP_nonlinear5(100,10,c(1:10),c(1:10))
```

# Index