Package 'BackToSchool'

June 29, 2020

Title Implement agent-based model of COVID-19 in elementary schools

Version 0.0.0.9000

Imports tidyverse, igraph

Description This package allows users to run an agent-based model of COVID-19 transmission in elementary schools, customized to a particular setting.

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Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.1.0.9000

R topics documented:

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initialize_school   *Initialize school*

Description

This function takes in a data frame exported by make_school(). It adds epidemiological attributes of the full school community.

Usage

```
initialize_school(
  n_contacts = 10,
  n_contacts_brief = 0,
  rel_trans_HH = 1,
  rel_trans = 1/8,
  rel_trans_brief = 1/50,
  p_asymp_adult = 0.35,
  p_asymp_child = 0.7,
  attack = 0.01,
  child_trans = 1,
  child_susp = 1/3,
  teacher_trans = 1,
  teacher_susp = 1,
  disperse_transmission = T,
  isolate = 1,
  dedens = F,
  run_specials = F,
  start
)
```

Arguments

n_contacts	Number of sustained contacts outside of the classroom; defaults to 10
n_contacts_brief	
	Number of brief contacts outside of the classroom; defaults to 0
rel_trans_HH	Relative attack rate of household contact (vs. classrom); defaults to 1
rel_trans	Relative attack rate of sustained contact (vs. classroom); defaults to 1/8
rel_trans_brief	
	Relative attack rate of brief contact (vs. classroom); defaults to 1/50
p_asymp_adult	Fraction of adults with asymptomatic (unsuspected) disease; defaults to 0.35
p_asymp_child	Fraction of children with asymptomatic (unsuspected) disease; defaults to 0.7
attack	Average daily attack rate in adults; defaults to 0.01
child_trans	Relative transmissibility of children (vs. adults); defaults to 1
child_susp	Relative transmissibility of children (vs. adults); defaults to 1
teacher_trans	Factor by which teacher transmissibility is reduced due to intervention; defaults to 1
teacher_susp	Factor by which teacher transmissibility is reduced due to intervention; defaults to 1

disperse_transmission	
	Whether transmission is overdispersed (vs. all have equal attack rate); default to T
isolate	Whether symptomatic individuals isolate when symptoms emerge; defaults to T
dedens	Whether dedensification measures reduce attack rate; defaults to F
run_specials	Whether special subjects are run; defaults to F
start	Data frame from make_class()

Value

out data frame of child and teacher attributes.

---

make_infected *Set infection parameters*

Description

Set infection parameters for individuals infected at a particular timestep

Usage

```
make_infected(df.u, days_inf, set = NA, mult_asymp = 1, seed_asymp = F)
```

Arguments

set	indication of seeding model vs. creating infections
mult_asymp	multiplier on asymptomatic infection; default is 1
seed_asymp	when making a seed, force to be asymptomatic; default is false
a	id of infected individual
df	school data frame from make_school()

Value

df.u with updated parameters

---

make_schedule *Make schedule*

Description

Make a schedule of when individuals in the school community are present/absent

Usage

```
make_schedule(time = 30, type = "base", total_days = 5, df)
```

Arguments

`time`	number of days; defaults to 30
`type`	"base", "On/off", "A/B"; defaults to "base"
`total_days`	number of days in school; defaults to 5
`df`	data frame from make_school()

Value

d Returns a n x time data frame that indicates whether an individual is in the school building at a particular time

---

`make_school`	*Make school*

Description

This function allows you to sort a synthetic population into classes. It also assigns children to groups for alternating schedules and ensures that children are in the same group as siblings. It adds non-primary teacher staff, and if families are included, includes two adult family members per child and one per adult staff member.

Usage

```
make_school(
  synthpop = synthMD,
  n_other_adults = 30,
  includeFamily = F,
  n_class = 4
)
```

Arguments

`synthpop`	synthetic population; defaults to synthMD stored in file
`n_other_adults`	Number of adults in the school other than primary teachers; defaults to 30
`includeFamily`	whether to include family and adult family members of teachers, default = FALSE
`n_class`	number of classes per grade

Value

out data frame of child and teacher attributes

---

mult_runs   *Run model multiple times and summarize results*

Description

Run model multiple times and summarize results

Usage

```
mult_runs(
  N = 500,
  n_other_adults = 30,
  n_contacts = 10,
  n_contacts_brief = 0,
  rel_trans_HH = 1,
  rel_trans = 1/8,
  rel_trans_brief = 1/50,
  p_asymp_adult = 0.35,
  p_asymp_child = 0.7,
  attack = 0.01,
  child_trans = 1,
  child_susp = 1,
  teacher_trans = 1,
  teacher_susp = 1,
  disperse_transmission = T,
  n_staff_contact = 0,
  n_HH = 0,
  n_start = 1,
  days_inf = 6,
  mult_asymp = 1,
  seed_asymp = F,
  isolate = T,
  dedens = 0,
  run_specials_now = F,
  time = 30,
  notify = F,
  test = F,
  test_sens = 0.7,
  test_frac = 0.9,
  test_days = NA,
  type = "base",
  total_days = 5,
  includeFamily = F,
  synthpop = synthMD,
  class = NA
)
```

Arguments

N	number of runs
n_other_adults	Number of adults in the school other than primary teachers; defaults to 30

n_contacts	Number of sustained contacts outside of the classroom; defaults to 10
n_contacts_brief	
	Number of brief contacts outside of the classroom; defaults to 20
rel_trans_HH	Relative attack rate of household contact (vs. classrom); defaults to 1
rel_trans	Relative attack rate of sustained contact (vs. classrom); defaults to 1/8
rel_trans_brief	
	Relative attack rate of brief contact (vs. classroom); defaults to 1/50
p_asymp_adult	Fraction of adults with asymptomatic (unsuspected) disease; defaults to 0.35
p_asymp_child	Fraction of children with asymptomatic (unsuspected) disease; defaults to 0.7
attack	Average daily attack rate in adults; defaults to 0.01
child_trans	Relative transmissibility of children (vs. adults); defaults to 1
child_susp	Relative transmissibility of children (vs. adults); defaults to 1
teacher_trans	Factor by which teacher transmissibility is reduced due to intervention; defaults to 1
teacher_susp	Factor by which teacher transmissibility is reduced due to intervention; defaults to 1
disperse_transmission	
	Whether transmission is overdispersed (vs. all have equal attack rate); default to T
n_staff_contact	
	number of contacts a teacher/staff member has with other teachers/staff members
n_HH	number of households a household interacts with when not attending school; defaults to 0
n_start	number of infections to seed model; defaults to 1
days_inf	length of infectious period (assuming mild case or quarantined on symptoms)
mult_asymp	multiplier on asymptomatic infection; default is 1
seed_asymp	whether to seed with an asymptomatic case
isolate	Whether symptomatic individuals isolate when symptoms emerge; defaults to T
dedens	Whether dedensification measures reduce attack rate; defaults to F
time	length of time to run model; defaults to 30
notify	whether classrooms are notified and quarantined; defaults to F
test	whether there is weekly testing; defaults to F
test_sens	test sensitivity; defaults to 0.7
test_frac	fraction of school tested; defaults to 0.9
test_days	vector indicating days on which students are tested; defaults to Sundays
type	"base", "On/off", "A/B"; defaults to "base"
total_days	number of days in school; defaults to 5
includeFamily	whether to include family, default = FALSE
synthpop	synthetic population; defaults to synthMD
run_specials	Whether special subjects are run; defaults to F

---

results   *Summarize multiple runs*

Description

Summarize multiple runs

Usage

```
results(out)
```

Arguments

out   output from mult_runs

Value

calc summarizes results from multiple runs

---

run_care   *Set care-based transmission*

Description

Determine who is infected at a timestep from contact with an infected individual out of school

Usage

```
run_care(a, df, contacts)
```

Arguments

a   id of infected individual

df   school data frame from make_school()

contacts   graph of random contacts at time t

Value

infs id of infected individuals

---

run_class   *Set class transmission*

Description

Determine who is infected at a timestep in the same classroom as an infected individual

Usage

```
run_class(a, df)
```

Arguments

a	id of infected individual
df	school data frame from make_school()

Value

infs id of infected individuals

---

run_household   *Set household transmission*

Description

Determine who is infected at a timestep in the same household as an infected individual

Usage

```
run_household(a, df)
```

Arguments

a	id of infected individual
df	school data frame from make_school()

Value

infs id of infected individuals

```
run_model                    Run model
```

Description

Perform a single model run

Usage

```
run_model(
  time = 30,
  notify = F,
  test = F,
  test_days = NA,
  test_sens = 0.7,
  test_frac = 0.9,
  n_staff_contact = 0,
  n_HH = 0,
  n_start = 1,
  days_inf = 6,
  mult_asymp = 1,
  seed_asymp = F,
  df,
  sched
)
```

Arguments

time	length of time to run model; defaults to 30
notify	whether classrooms are notified and quarantined; defaults to F
test	whether there is weekly testing; defaults to F
test_sens	test sensitivity; defaults to 0.7
test_frac	fraction of school tested; defaults to 0.9
n_staff_contact	
	number of contacts a teacher/staff member has with other teachers/staff members; defaults to 0
n_HH	number of households a household interacts with when not attending school; defaults to 0
n_start	number of infections to seed model; defaults to 1
days_inf	length of infectious period (assuming mild case or quarantined on symptoms)
mult_asymp	multiplier on asymptomatic infection; default is 1
seed_asymp	whether to seed with an asymptomatic case
df	school data frame from make_school()
sched	schedule data frame from make_schedule()

Value

df updated df with transmission results

time_seed_inf when the first individual was dropped in

class_quarantine a matrix of class quarantine times

mat a check on if the people who you think are present are actually the ones present

---

run_rand *Set random transmission*

Description

Determine who is infected at a timestep from random contact with an infected individual

Usage

```
run_rand(a, df, random_contacts)
```

Arguments

a   id of infected individual

df   school data frame from make_school()

random_contacts

        graph of random contacts at time t

Value

infs id of infected individuals

---

run_specials *Set specials transmission*

Description

Determine who is infected at a timestep from specials

Usage

```
run_specials(a, df, specials)
```

Arguments

a   id of infected individual

df   school data frame from make_school()

specials   classroom and teacher ids of specials at time t

Value

infs id of infected individuals

---

run_staff_rand *Set random staff transmission*

Description

Determine who is infected at a timestep from random contact between in-school adults

Usage

```
run_staff_rand(a, df, random_contacts)
```

Arguments

a	id of infected individual
df	school data frame from make_school()
random_contacts	
	graph of random contacts at time t

Value

infs id of infected individuals

---

synthMD *Synthetic Maryland population*

Description

A data frame containing a synthetic population of children ages 5-10, representative of the state of Maryland. This is used by make_class() to sort children into classes.

Usage

```
data(synthMD)
```

Format

A data frame with

HH_id household ID

age age

flag_mult true if more than one child in the household, not used

id individual id #

Source

Wheaton, W.D., U.S. Synthetic Population 2010 Version 1.0 Quick Start Guide, RTI International, May 2014. (website). Created with script demographic_data2.R.

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