emod-api

Institute for Disease Modeling

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CONTENTS

emod-api is the interface for Epidemiological MODeling software (EMOD) that users of idmtools interact with to create and modify EMOD simulations. Additional functionality for interacting with EMOD is provided in the emodpy package and idmtools.

See Welcome to idmtools for a diagram showing how idmtools and each of the related packages are used in an end-to-end workflow using EMOD as the disease transmission model.

CHAPTER

ONE

EMOD-API INSTALLATION

Follow the steps below to install emod-api.

1.1 Prerequisites

First, ensure the following prerequisites are met.

- Windows 10 Pro or Enterprise, Linux, or Mac
- Python 3.9 64-bit (https://www.python.org/downloads/release)
- A file that indicates the pip index-url:
  - Windows
  - Linux

  In C:\Users\Username\pip\pip.ini, containing the following:

```
[global]
index-url = https://packages.idmod.org/api/pypi/pypi-production/simple
```

  In $HOME/.config/pip/pip.conf, containing the following:

```
[global]
index-url = https://packages.idmod.org/api/pypi/pypi-production/simple
```

1.2 Installation instructions

1. Open a command prompt and create a virtual environment in any directory you choose. The command below names the environment "v-emod-api", but you may use any desired name:

```
python -m venv v-emod-api
```

2. Activate the virtual environment:
   - Windows
   - Linux

   Enter the following:

```
v-emod-api\Scripts\activate
```

Enter the following:

```
source v-emod-api/bin/activate
```

3. Install emod-api packages:

```
pip install emod-api
```

If you are on Linux, also run:

```
pip install keyrings.alt
```

4. When you are finished, deactivate the virtual environment by entering the following at a command prompt:

```
deactivate
```

1.3 Windows

To properly install Shapely on Windows and/or if Snappy compression support is desired or needed, consider downloading and installing the latest python-snappy package for Windows from Christoph Gohlke's python package website.

CHAPTER

TWO

FREQUENTLY ASKED QUESTIONS

As you get started with emod-api, you may have questions. The most common questions are answered below. If you are using emodpy packages, see the FAQs from those packages for additional guidance.

I notice that I can import emod_api.campaign and use that as an object. I haven't seen that before. Sure. Python modules are a lot like singletons. There's no need to add a static class inside that module in many cases. Think of the module (which can have variables and methods) as a static class.

Is there a function to write a demographics configuration to disk? Yes. The main Demographics class has a function called generate_file(). https://docs.idmod.org/projects/emod-api/en/latest/emod_api.demographics.Demographics.html#emod_api.demographics.Demographics.Demographics.generate_file

CHAPTER

THREE

API REFERENCE

3.1 emod_api package

To generate a config.json from a param_overrides.json (or params-of-interest.json): python -m emod_api.config.from_overrides </path/to/po.json>

To generate a default config.json based on the schema for a given Eradication binary: python -m emod_api.config.from_schema -e </path/to/Eradication.[exe]> ...

To generate a schema.json: python -m emod_api.schema.get_schema </path/to/Eradication[.exe]>

For rest of emod-api documentation, please go to https://github.com/InstituteforDiseaseModeling/emod-api

3.1.1 Subpackages

emod_api.channelreports package

Submodules

emod_api.channelreports.channels module

Module for reading InsetChart.json channels.

class emod_api.channelreports.channels.**Header**(***kwargs*)

Bases: object

property num_channels: int

property dtk_version: str

property time_stamp: str

property report_type: str

property report_version: str

property step_size: int
>= 1

property start_time: int
>= 0

property num_time_steps: int
>= 1

as_dictionary() → Dict

class emod_api.channelreports.channels.**Channel**(*title: str*, *units: str*, *data: List*)
Bases: object

property title: str

property units: str

property data

as_dictionary() → Dict

class emod_api.channelreports.channels.**ChannelReport**(*filename: Optional[str] = None*, ***kwargs*)
Bases: object

property header: *emod_api.channelreports.channels.Header*

property dtk_version: str

property time_stamp: str

property report_type: str

property report_version: str
major.minor

property step_size: int
>= 1

property start_time: int
>= 0

property num_time_steps: int
> 0

property num_channels: int

property channel_names: List

property channels: Dict
Channel objects keyed on channel name/title

as_dataframe() → pandas.core.frame.DataFrame
Return underlying data as a Pandas DataFrame

write_file(*filename: str*, *indent: int = 0*, *separators=(',', ':')*) → None
Write inset chart to specified text file.

to_csv(*filename: Union[str, pathlib.Path]*, *channel_names: Optional[List[str]] = None*, *transpose: bool = False*) → None
Write each channel from the report to a row, CSV style, in the given file.

Channel name goes in the first column, channel data goes into subsequent columns.

Parameters

- **filename** – string or path specifying destination file
- **channel_names** – optional list of channels (by name) to write to the file
- **transpose** – write channels as columns rather than rows

emod_api.channelreports.plot_icj_means module

emod_api.channelreports.plot_icj_means.**collect**(*exp_id*, *chan='Infected'*, *tag=None*, *smoothing=True*)
Collect all the time series data for a given channel for a given experiment from InsetChart.json files in local subdirectory that have been downoaded from COMPS, assuming following structure.

exp_id/

sim_id/ InsetChart.json

Parameters

- **exp_id** – Experiment Id that has had data downloaded to current working diretory.
- **chan** – Channel name
- **tag** – key=value. Using results.db (sqlite3, from emodpy), limit results to just where key=value. If value is set to SWEEP, find all values for key and plot all values separately (but with mean/spread from other tags).

Returns Array of channel data for further processing.

emod_api.channelreports.plot_icj_means.**display**(*chan_data*, *save=False*, *chan_name='Infected'*, *exp_id=None*)
Plot mean and std dev of the array/list of time series-es in chan_data.

emod_api.channelreports.plot_prop_report module

Command line utility for plotting property reports.

emod_api.channelreports.plot_prop_report.**main**(*args: argparse.Namespace*)
Plot specified property report with the given options.

emod_api.channelreports.plot_prop_report.**list_channels_and_ips**(*channel_keys: List[str]*) → None
List the channels and properties found in a property report from the CHANNEL:IP:value,. . . ,IP:value keys of the channel dictionary.

emod_api.channelreports.plot_prop_report.**call_plot_traces**(*args: argparse.Namespace*, *trace_values: Dict[str, numpy.ndarray]*) → None
Call the internal *plot_traces* function and, optionally, save the results to disk.

emod_api.channelreports.plot_prop_report.**process_cmd_line**() → argparse.Namespace
Put command line processing here rather than in *if 'name' == '__main__'*.

emod_api.channelreports.utils module

Helper functions, primarily for property reports, which are channel reports.

emod_api.channelreports.utils.**property_report_to_csv**(*source_file: Union[str, pathlib.Path]*, *csv_file: Union[str, pathlib.Path]*, *channels: Optional[List[str]] = None*, *groupby: Optional[List[str]] = None*, *transpose: bool = False*) → None
Write a property report to a CSV formatted file.

Optionally selected a subset of available channels. Optionally "rolling-up" IP:value sub-channels into a "parent" IP.

Parameters

- **source_file** – filename of property report
- **channels** – list of channels to output, None results in writing _all_ channels to output
- **groupby** – list of IPs into which to aggregate remaining IPs, None indicates no grouping, [] indicates _all_ aggregated
- **csv_file** – filename of CSV formatted result
- **transpose** – write channels as columns rather than rows

emod_api.channelreports.utils.**read_json_file**(*filename: Union[str, pathlib.Path]*) → Dict

emod_api.channelreports.utils.**get_report_channels**(*json_data: Dict*) → Dict

emod_api.channelreports.utils.**accumulate_channel_data**(*channels: List[str]*, *verbose: bool*, *groupby: List[str]*, *channel_data: Dict*) → Dict[str, numpy.ndarray]

Extract selected channel(s) from property report data.

Aggregate on groupby IP(s), if provided, otherwise on channel per unique IP:value pair (e.g., "QualityOfCare:High"), per main channel (e.g., "Infected").

Parameters

- **channels** – names of channels to plot
- **verbose** – output some "debugging"/progress information if true
- **groupby** – IP(s) under which to aggregate other IP:value pairs
- **channel_data** – data for channels keyed on channel name

Returns tuple of dictionary of aggregated data, keyed on channel name, and of Numpy array of normalization values

emod_api.channelreports.utils.**save_to_csv**(*trace_values: Dict[str, numpy.ndarray]*, *filename: Union[str, pathlib.Path]*, *transpose: bool = False*) → None

Save property report to CSV. Uses underlying ChannelReport.to_csv() function.

Parameters

- **trace_values** – full set of available channels, keyed on channel name
- **filename** – destination file for CSV data
- **transpose** – write channels as columns rather than rows

emod_api.channelreports.utils.**plot_traces**(*trace_values: Dict[str, numpy.ndarray]*, *norm_values: Optional[Union[int, numpy.ndarray]]*, *overlay: bool*, *channels: List[str]*, *title: str*, *legend: bool*) → matplotlib.figure.Figure

Plot trace data. One subplot per channel unless overlaying all variations of rolled-up IP(s) is requested.

A trace (like old-time pen and ink EKG) may represent the aggregation of several IP values so trace may not equal any particular channel data.

Parameters

- **trace_values** – channel data, keyed on channel name
- **norm_values** – normalization data for channels
- **overlay** – whether or not to overlay all variations of a given channel on one subplot

- **channels** – selection of channel names to plot
- **title** – plot title
- **legend** – whether or not to include a legend on plots

Returns plt.Figure

emod_api.config package

Submodules

emod_api.config.default_from_schema module

emod_api.config.default_from_schema.**write_default_from_schema**(*path_to_schema*)
This module is deprecated. Please use default_from_schema_no_validation.

emod_api.config.default_from_schema_no_validation module

emod_api.config.default_from_schema_no_validation.**schema_to_config_subnode**(*schema_path_in*, *subnode_list*)
This is the code from regular schema_to_config:

config = json.load(open("default_config.json"), object_hook=s2c.ReadOnlyDict) os.remove("default_config.json")

emod_api.config.default_from_schema_no_validation.**get_default_config_from_schema**(*path_to_schema*, *schema_node=True*, *as_rod=False*, *output_filename=None*)
This returns a default config object as defined from reading a schema file.

Parameters **output_filename** (*str*) – if not None, the path to write the loaded config to

emod_api.config.default_from_schema_no_validation.**write_default_from_schema**(*path_to_schema*, *output_filename='default_config.json'*, *schema_node=True*)
DEPRECATED: This function simply calls get_default_config_from_schema with specific arguments.

This function writes out a default config file as defined from reading a schema file. It's as good as the schema it's given. Note that this is designed to work with a schema from a disease-specific build, otherwise it may contain a lot of params from other disease types.

emod_api.config.default_from_schema_no_validation.**load_default_config_as_rod**(*config*)

Parameters **config** (*string/path*) – path to default or base config.json

Returns config (as ReadOnlyDict) with schema ready for schema-verified param sets.

emod_api.config.default_from_schema_no_validation.**get_config_from_default_and_params**(*config_path=None*, *set_fn=None*, *config=None*)
Use this function to create a valid config.json file from a schema-derived base config, a callback that sets your parameters of interest

Parameters

- **config_path** (*string/path*) – Path to valid config.json
- **config** – read-only dict configuration object. Pass this XOR the config_path.
- **set_fn** (*function*) – Callback that sets params with implicit schema enforcement.

Returns read-only dict

Return type config

emod_api.config.default_from_schema_no_validation.**write_config_from_default_and_params**(*config_path*, *set_fn*, *config_out_path*)

Use this function to create a valid config.json file from a schema-derived base config, a callback that sets your parameters of interest, and an output path.

Parameters

- **config_path** (*string/path*) – Path to valid config.json
- **set_fn** (*function*) – Callback that sets params with implicit schema enforcement.
- **config_out_path** – (string/path) Path to write new config.json

Returns Nothing

emod_api.config.dtk_post_process_adhocevents module

emod_api.config.dtk_post_process_adhocevents.**application**(*output_path*)

emod_api.config.dtk_pre_process_adhocevents module

emod_api.config.dtk_pre_process_adhocevents.**do_mapping_from_events**(*config*, *adhoc_events*)
Given a config file, a campaign file, and a list of adhoc_events, do the mappings. The adhoc_event list originally came from scraping an existing campaign file but now comes from emod_api.campaign.

emod_api.config.dtk_pre_process_adhocevents.**application**(*config*)
This is the public interface function to the submodule.

emod_api.config.dtk_pre_process_w5ml module

emod_api.config.dtk_pre_process_w5ml.**application**(*filename*)

emod_api.config.from_overrides module

emod_api.config.from_overrides.**flattenConfig**(*configjson_path*, *new_config_name='config.json'*)
Historically called 'flattening' but really a function that takes a parameter override json config that includes a Default_Config_Path and produces a config.json from the two.

emod_api.config.from_poi_and_binary module

emod_api.config.from_poi_and_binary.**schema_to_config**(*schema_path_in*)
Purpose: Take a schema.json and return a "smart" config object that can be assigned to with schema-enforcement. Use in conjunction with to_file(). Params: schema_path_in (str/path) Returns: config (smart dict)

emod_api.config.from_poi_and_binary.**set_schema**(*schema_path_in*)

emod_api.config.from_poi_and_binary.**make_config_from_poi_and_config_dict**(*start_config_dict*, *poi_set_param_fn*)
Use this function to create a config.json from an existing param dict (defaults or base) and a function with your parameter overrides or parameters of interest.

emod_api.config.from_poi_and_binary.**make_config_from_poi_and_config_file**(*start_config_path*, *poi_set_param_fn*)
Use this function to create a config.json from an existing config json file (defaults or base) and a function with your parameter overrides or parameters of interest.

emod_api.config.from_poi_and_binary.**make_config_from_poi_and_schema**(*schema_path*, *poi_set_param_fn*)
Use this function to create a config.json from an existing schema json file and a function with your parameter overrides or parameters of interest.

emod_api.config.from_poi_and_binary.**make_config_from_poi**(*eradication_path*, *poi_set_param_fn*)
This function uses emod_api to produce a guaranteed working config starting with an Eradication binary and a parameters-of-interest python function. This is a usable and useful function.

Parameters

- **eradication_path** (*string*) – Fully-qualified path to Eradication binary that can be invoked to get a schema.
- **poi_set_param_fn** (*function*) – User-provided function/callback/hook that looks like:
- **set_params** (*def*) – config.parameters.<param_name> = <schema valid param_value> <repeat for each param> return config

Returns Hardcoded configuration filename written to pwd.

Return type "config.json" (string)

emod_api.config.from_schema module

argparse for command-line usage -s schema file -m model name -c config file

Sample code: from emod_api.config import schema_to_config as s2c builder = s2c.SchemaConfigBuilder() builder.enumerate_params() builder.validate_dependent_params() builder.write_config_file()

That will look for a local file called schema.json and produce a file called config.json that should work with an Eradication binary that produced the schema.json.

To build a default config for MALARIA_SIM, do: builder = s2c.SchemaConfigBuilder(model="MALARIA_SIM")

To generate a schema.json file from a binary, see help text for emod_api.schema.

class emod_api.config.from_schema.**SchemaConfigBuilder**(*schema_name='schema.json'*, *model='GENERIC_SIM'*, *config_out='config.json'*, *debug=False*)
Bases: object

emod_api.config.schema_to_config module

class emod_api.config.schema_to_config.**SchemaConfigBuilder**(*schema_name='schema.json'*, *model='GENERIC_SIM'*, *config_out='config.json'*, *debug=False*)

Bases: *emod_api.config.from_schema.SchemaConfigBuilder*

Deprecated in API v.1. Supported temporarily as pass-through functionality to emod_api.config.from_schema.

emod_api.demographics package

Submodules

emod_api.demographics.BaseInputFile module

class emod_api.demographics.BaseInputFile.**BaseInputFile**(*idref*)

Bases: object

abstract generate_file(*name*)

generate_headers(*extra=None*)

emod_api.demographics.Demographics module

emod_api.demographics.Demographics.**from_template_node**(*lat=0*, *lon=0*, *pop=1000000*, *name='Erewhon'*, *forced_id=1*)

Create a single-node Demographics instance from a few params.

emod_api.demographics.Demographics.**from_file**(*base_file*)

Create a Demographics instance from an existing demographics file.

emod_api.demographics.Demographics.**get_node_ids_from_file**(*demographics_file*)

Get a list of node ids from a demographics file.

emod_api.demographics.Demographics.**get_node_pops_from_params**(*tot_pop*, *num_nodes*, *frac_rural*)

Get a list of node populations from the params used to create a sparsely parameterized multi-node Demographics instance.

emod_api.demographics.Demographics.**from_params**(*tot_pop=1000000*, *num_nodes=100*, *frac_rural=0.3*, *id_ref='from_params'*, *random_2d_grid=False*)

Create an EMOD-compatible Demographics object with the population and numbe of nodes specified.

Parameters

- **tot_pop** – The total population.
- **num_nodes** – Number of nodes. Can be defined as a two-dimensional grid of nodes [longitude, latitude]. The distance to the next neighbouring node is 1.
- **frac_rural** – Determines what fraction of the population gets put in the 'rural' nodes, which means all nodes besides node 1. Node 1 is the 'urban' node.
- **id_ref** – Facility name
- **random_2d_grid** – Create a random distanced grid with num_nodes nodes.

Returns Object of type Demographics

emod_api.demographics.Demographics.**from_csv**(*input_file*, *res=0.008333333333333333*, *id_ref='from_csv'*)

Create an EMOD-compatible Demographics instance from a csv population-by-node file.

emod_api.demographics.Demographics.**from_pop_csv**(*pop_filename_in*, *pop_filename_out='spatial_gridded_pop_dir'*, *site='No_Site'*)

class emod_api.demographics.Demographics.**Demographics**(*nodes*, *idref='Gridded world grump2.5arcmin'*, *base_file=None*)

Bases: *emod_api.demographics.BaseInputFile.BaseInputFile*

This class is a container of data necessary to produce a EMOD-valid demographics input file. It can be initialized from an existing valid demographics.joson type file or from an array of valid Nodes.

apply_overlay(*overlay_nodes: list*)

Parameters **overlay_nodes** – Overlay list of nodes over existing nodes in demographics

Returns

to_dict()

generate_file(*name='demographics.json'*)

Write the contents of the instance to an EMOD-compatible (JSON) file.

send(*write_to_this*, *return_from_forked_sender=False*)

Write data to a file descriptor as specified by the caller. It must be a pipe, a filename, or a file 'handle'

Parameters

- **write_to_this** – File pointer, file path, or file handle.
- **return_from_forked_sender** – Defaults to False. Only applies to pipes. Set to true if caller will handle exiting of fork.

Example:

```
1) Send over named pipe client code
# Named pipe solution 1, uses os.open, not open.
import tempfile
tmpfile = tempfile.NamedTemporaryFile().name
os.mkfifo( tmpfile )

fifo_reader = os.open( tmpfile, os.O_RDONLY |  os.O_NONBLOCK )
fifo_writer = os.open( tmpfile, os.O_WRONLY |  os.O_NONBLOCK )
demog.send( fifo_writer )
os.close( fifo_writer )
data = os.read( fifo_reader, int(1e6) )

2) Send over named pipe client code version 2 (forking)
import tempfile
tmpfile = tempfile.NamedTemporaryFile().name
os.mkfifo( tmpfile )

process_id = os.fork()
# parent stays here, child is the sender
if process_id:
    # reader
```

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```
    fifo_reader = open( tmpfile, "r" )
    data = fifo_reader.read()
    fifo_reader.close()
else:
    # writer
    demog.send( tmpfile )

3) Send over file.
import tempfile
tmpfile = tempfile.NamedTemporaryFile().name
# We create the file handle and we pass it to the other module which writes to␣
↪it.
with open( tmpfile, "w" ) as ipc:
    demog.send( ipc )

# Assuming the above worked, we read the file from disk.
with open( tmpfile, "r" ) as ipc:
    read_data = ipc.read()

os.remove( tmpfile )
```

Returns N/A

property node_ids
Return the list of (geographic) node ids.

property nodes

property node_count
Return the number of (geographic) nodes.

get_node(*nodeid*)
Return the node idendified by nodeid. Search either name or actual id :param nodeid: :return:

SetMigrationPattern(*pattern: str = 'rwd'*)
Set migration pattern. Migration is enabled implicitly. It's unusual for the user to need to set this directly; normally used by emodpy.

Parameters **pattern** – Possible values are "rwd" for Random Walk Diffusion and "srt" for Single Round Trips.

SetRoundTripMigration(*gravity_factor*, *probability_of_return=1.0*, *id_ref='short term commuting migration'*)
Set commuter/seasonal/temporary/round-trip migration rates. You can use the x_Local_Migration configuration parameter to tune/calibrate.

Parameters

- **gravity_factor** – 'Big G' in gravity equation. Combines with 1, 1, and -2 as the other exponents.
- **probability_of_return** – Likelihood that an individual who 'commuter migrates' will return to the node of origin during the next migration (not timestep). Defaults to 1.0. Aka, travel, shed, return."
- **id_ref** – Text string that appears in the migration file itself; needs to match corresponding demographics file.

SetOneWayMigration(*rates_path*, *id_ref='long term migration'*)
Set one way migration. You can use the x_Regional_Migration configuration parameter to tune/calibrate.

Parameters

- **rates_path** – Path to csv file with node-to-node migration rates. Format is: source (node id),destination (node id),rate.
- **id_ref** – Text string that appears in the migration file itself; needs to match corresponding demographics file.

SetSimpleVitalDynamics(*crude_birth_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*, *crude_death_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*, *node_ids=None*)
Set fertility, mortality, and initial age with single birth rate and single mortality rate.

Parameters

- **crude_birth_rate** – Birth rate, per year per kiloperson.
- **crude_death_rate** – Mortality rate, per year per kiloperson.
- **node_ids** – Optional list of nodes to limit these settings to.

SetEquilibriumVitalDynamics(*crude_birth_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*, *node_ids=None*)
Set fertility, mortality, and initial age with single rate and mortality to achieve steady state population.

Parameters

- **crude_birth_rate** – Birth rate. And mortality rate.
- **node_ids** – Optional list of nodes to limit these settings to.

SetEquilibriumVitalDynamicsFromWorldBank(*wb_births_df*, *country*, *year*, *node_ids=None*)
Set steady-state fertility, mortality, and initial age with rates from world bank, for given country and year.

Parameters

- **wb_births_df** – Pandas dataframe with World Bank birth rate by country and year.
- **country** – Country to pick from World Bank dataset.
- **year** – Year to pick from World Bank dataset.
- **node_ids** – Optional list of nodes to limit these settings to.

SetIndividualAttributesWithFertMort(*crude_birth_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*, *crude_mort_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*)

AddIndividualPropertyAndHINT(*Property: str*, *Values: List[str]*, *InitialDistribution: Optional[List[float]] = None*, *TransmissionMatrix: Optional[List[List[float]]] = None*, *Transitions: Optional[List] = None*)
Add Individual Properties, including an optional HINT configuration matrix.

Parameters

- **Property** – property (if property already exists an exception is raised).
- **Values** – property values.
- **InitialDistribution** – initial distribution.

- **TransmissionMatrix** – transmission matrix.

Returns N/A/

AddAgeDependentTransmission(*Age_Bin_Edges_In_Years=[0, 1, 2, - 1]*, *TransmissionMatrix=[[1.0, 1.0, 1.0], [1.0, 1.0, 1.0], [1.0, 1.0, 1.0]]*)

Set up age-based HINT. Since ages are a first class property of an agent, Age_Bin is a special case of HINT. We don't specify a distribution, but we do specify the age bin edges, in units of years. So if Age_Bin_Edges_In_Years = [0, 10, 65, -1] it means you'll have 3 age buckets: 0-10, 10-65, & 65+. Always 'book-end' with 0 and -1.

Parameters

- **Age_Bin_Edges_In_Years** – array (or list) of floating point values, representing the age bucket bounderies.
- **TransmissionMatrix** – 2-D array of floating point values, representing epi connectedness of the age buckets.

SetDefaultIndividualAttributes()

NOTE: This is very Measles-ish. We might want to move into MeaslesDemographics

SetMinimalNodeAttributes()

SetBirthRate(*birth_rate*, *node_ids=None*)

Set Default birth rate to birth_rate. Turn on Vital Dynamics and Births implicitly.

SetMortalityRate(*mortality_rate:* emod_api.demographics.DemographicsTemplates.CrudeRate, *node_ids: Optional[List[int]] = None*)

Set constant mortality rate to mort_rate. Turn on Enable_Natural_Mortality implicitly.

SetMortalityDistribution(*distribution: Optional[*emod_api.demographics.PropertiesAndAttributes.IndividualAttributes.MortalityDistribut *= None*, *node_ids: Optional[List[int]] = None*)

Set a default mortality distribution for all nodes or per node. Turn on Enable_Natural_Mortality implicitly.

Parameters

- **distribution** – distribution
- **node_ids** – a list of node_ids

Returns None

SetMortalityOverTimeFromData(*data_csv*, *base_year*, *node_ids=[]*)

Set default mortality rates for all nodes or per node. Turn on mortality configs implicitly. You can use the x_Other_Mortality configuration parameter to tune/calibrate.

Parameters

- **data_csv** – Path to csv file with the mortality rates by calendar year and age bucket.
- **base_year** – The calendar year the sim is treating as the base.
- **node_ids** – Optional list of node ids to apply this to. Defaults to all.

Returns None

SetAgeDistribution(*distribution:* emod_api.demographics.PropertiesAndAttributes.IndividualAttributes.AgeDistribution, *node_ids: Optional[List[int]] = None*)

Set a default age distribution for all nodes or per node. Sets distribution type to COMPLEX implicitly. :param distribution: age distribution :param node_ids: a list of node_ids

Returns None

SetDefaultNodeAttributes(*birth=True*)
Set the default NodeAttributes (Altitude, Airport, Region, Seaport), optionally including birth, which is most important actually.

SetDefaultIndividualProperties()
Initialize Individual Properties to empty.

SetDefaultProperties()
Set a bunch of defaults (age structure, initial susceptibility and initial prevalencec) to sensible values.

SetDefaultPropertiesFertMort(*crude_birth_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*, *crude_mort_rate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*)
Set a bunch of defaults (birth rates, death rates, age structure, initial susceptibility and initial prevalencec) to sensible values.

SetDefaultFromTemplate(*template*, *setter_fn=None*)
Add to the default IndividualAttributes using the input template (raw json) and set corresponding config values per the setter_fn. The template should always be constructed by a function in DemographicsTemplates. Eventually this function will be hidden and only accessed via separate application-specific API functions such as the ones below.

SetNodeDefaultFromTemplate(*template*, *setter_fn*)
Add to the default NodeAttributes using the input template (raw json) and set corresponding config values per the setter_fn. The template should always be constructed by a function in DemographicsTemplates. Eventually this function will be hidden and only accessed via separate application-specific API functions such as the ones below.

SetEquilibriumAgeDistFromBirthAndMortRates(*CrudeBirthRate=<emod_api.demographics.DemographicsTemplates.Cru object>*, *CrudeMortRate=<emod_api.demographics.DemographicsTemplates.CrudeRate object>*, *node_ids=None*)
Set the inital ages of the population to a sensible equilibrium profile based on the specified input birth and death rates. Note this does not set the fertility and mortality rates.

SetInitialAgeExponential(*rate=0.0001068*, *description=''*)
Set the initial age of the population to an exponential distribution with a specified rate. :param rate: rate :param description: description, why was this distribution chosen

SetInitialAgeLikeSubSaharanAfrica(*description=''*)
Set the initial age of the population to a overly simplified structure that sort of looks like sub-Saharan Africa. This uses the SetInitialAgeExponential. :param description: description, why was this age chosen?

SetOverdispersion(*new_overdispersion_value*, *nodes=[]*)
Set the overdispersion value for the specified nodes (all if empty).

SetConstantSusceptibility()
Set the initial susceptibilty for each new individual to a constant value of 1.0.

SetInitPrevFromUniformDraw(*min_init_prev*, *max_init_prev*, *description=''*)
Set Initial Prevalence (one value per node) drawn from an uniform distribution. :param min_init_prev: minimal initial prevalence :param max_init_prevalence: maximal initial prevalence :param description: description, why were these parameters chosen?

SetConstantRisk(*risk=1*, *description=''*)
Set the initial risk for each new individual to the same value, defaults to full risk :param risk: risk :param description: description, why was this parameter chosen?

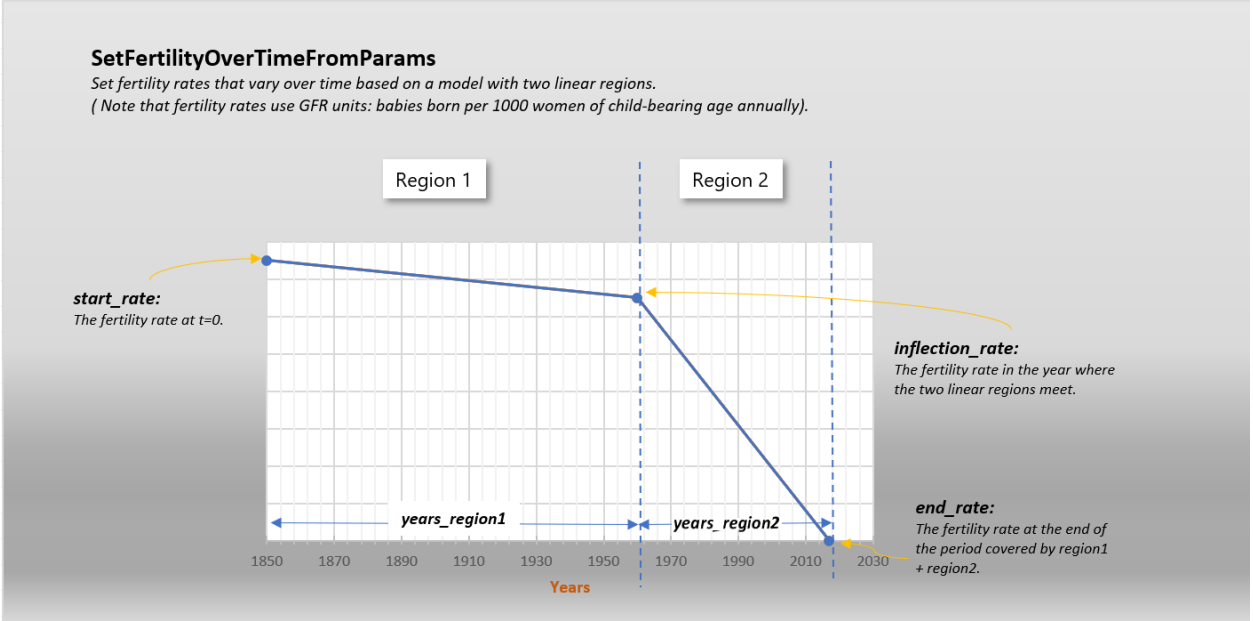
SetHeteroRiskUniformDist(*min_risk=0*, *max_risk=1*)
Set the initial risk for each new individual to a value drawn from a uniform distribution.

SetHeteroRiskLognormalDist(*mean=1.0*, *sigma=0*)
Set the initial risk for each new individual to a value drawn from a log-normal distribution.

SetHeteroRiskExponDist(*mean=1.0*)
Set the initial risk for each new individual to a value drawn from an exponential distribution.

SetFertilityOverTimeFromParams(*years_region1*, *years_region2*, *start_rate*, *inflection_rate*, *end_rate*, *node_ids=[]*)
Set fertility rates that vary over time based on a model with two linear regions. Note that fertility rates use GFR units: babies born per 1000 women of child-bearing age annually. You can use the x_Birth configuration parameter to tune/calibrate.

Refer to the following diagram.



Parameters

- **years_region1** – The number of years covered by the first linear region. So if this represents 1850 to 1960, years_region1 would be 110.
- **years_region2** – The number of years covered by the second linear region. So if this represents 1960 to 2020, years_region2 would be 60.
- **start_rate** – The fertility rate at t=0.
- **inflection_rate** – The fertility rate in the year where the two linear regions meet.
- **end_rate** – The fertility rate at the end of the period covered by region1 + region2.
- **node_ids** – Optional list of node ids to apply this to. Defaults to all.

Returns rates array (Just in case user wants to do something with them like inspect or plot.)

infer_natural_mortality(*file_male*, *file_female*, *interval_fit=[1970, 1980]*, *which_point='mid'*, *predict_horizon=2050*, *csv_out=False*, *n=0*, *results_scale_factor=0.0027397260273972603*)
Calculate and set the expected natural mortality by age, sex, and year from data, predicting what it would

have been without disease (usually HIV).

class emod_api.demographics.Demographics.**DemographicsOverlay**(*nodes=None*, *meta_data: Optional[dict] = None*, *individual_attributes=None*, *node_attributes=None*, *mortality_distribution=None*)

Bases: object

to_dict()

to_file(*file_name='demographics_overlay.json'*)

emod_api.demographics.DemographicsGenerator module

exception emod_api.demographics.DemographicsGenerator.**InvalidResolution**

Bases: BaseException

Custom Exception

class emod_api.demographics.DemographicsGenerator.**DemographicsType**(*value*)

Bases: enum.Enum

STATIC = 'static'

emod_api.demographics.DemographicsGenerator.**arcsec_to_deg**(*arcsec: float*) → float

Arc second to degrees :param arcsec: arcsecond as float

Returns arc second converted to degrees

emod_api.demographics.DemographicsGenerator.**validate_res_in_arcsec**(*res_in_arcsec*)

Validate that the resolution is valid :param res_in_arcsec: Resolution in arsecond. Supported values can be found in VALID_RESOLUTIONS

Returns None.

Raise: KeyError: If the resolution is invalid, a key error is raised

class emod_api.demographics.DemographicsGenerator.**DemographicsGenerator**(*nodes*, *concerns: Optional[Union[emod_api.dtk_tools.demog List[emod_api.dtk_tools.demographics.D = None*, *res_in_arcsec='custom'*, *node_id_from_lat_long=False*)

Bases: object

Generates demographics file based on population input file. The population input file is csv with structure

node_label*, lat, lon, pop*

*-ed columns are optional

set_resolution(*res_in_arcsec*)

The canonical way to set arcsecond/degree resolutions on a DemographicsGenerator object. Verifies everything is set properly

Parameters **res_in_arcsec** – The requested resolution. e.g. 30, 250, 'custom'

Returns: No return value.

generate_nodes(*defaults*)
generate demographics file nodes

The process for generating nodes starts with looping through the loaded demographics nodes. For each node, we: 1. First determine the node's id. If the node has a forced id set, we use that. If we are using a custom resolution, we use the index(ie 1, 2, 3…). Lastly, we build the node id from the lat and lon id of the node

2. We then start to populate the node_attributes and individual attributes for the current node. The node_attributes will have data loaded from the initial nodes fed into DemographicsGenerator. The individual attributes start off as an empty dict.

3. We next determine the birthrate for the node. If the node attributes contains a Country element, we first lookup the birthrate from the World Pop data. We then build a MortalityDistribution configuration with country specific configuration elements and add that to the individual attributes. If there is no Country element in the node attributes, we set the birth rate to the default_birth_rate. This value was set in initialization of the DemographicsGenerator to the birth rate of the specified country from the world pop data

4. We then calculate the per_node_birth_rate using get_per_node_birth_rate and then set the birth rate on the node attributes

5. We then calculate the equilibrium_age_distribution and use that to create the AgeDistribution in individual_attributes

6. We then add each new demographic node to a list to end returned at the end of the function

generate_metadata()
generate demographics file metadata

generate_demographics()
return all demographics file components in a single dictionary; a valid DTK demographics file when dumped as json

emod_api.demographics.DemographicsGenerator.**from_dataframe**(*df*, *demographics_filename: Optional[str] = None*, *concerns: Optional[Union[emod_api.dtk_tools.demographics.Demogra List[emod_api.dtk_tools.demographics.DemographicsGen = None*, *res_in_arcsec='custom'*, *node_id_from_lat_long=True*, *default_population: int = 1000*, *load_other_columns_as_attributes=False*, *include_columns: Optional[List[str]] = None*, *exclude_columns: Optional[List[str]] = None*, *nodeid_column_name: Optional[str] = None*, *latitude_column_name: str = 'lat'*, *longitude_column_name: str = 'lon'*, *population_column_name: str = 'pop'*)

Generates a demographics file from a dataframe

Parameters

- **df** – pandas DataFrame containing demographics information. Must contain all the columns specified by latitude_column_name, longitude_column_name. The population_column_name is optional. If not found, we fall back to default_population
- **demographics_filename** – demographics file to save the demographics file too. This is optional

- **concerns** (*Optional[DemographicsNodeGeneratorConcern]*) – What DemographicsNodeGeneratorConcern should
- **DefaultWorldBankEquilibriumConcern** (*we apply. If not specified, we use the*) –
- **res_in_arcsec** – Resolution in Arcseconds
- **node_id_from_lat_long** – Determine if we should calculate the node id from the lat long. By default this is true unless you also set res_in_arcsec to CUSTOM_RESOLUTION. When not using lat/long for ids, the first fallback it to check the node for a forced id. If that is not found, we assign it an index as id
- **load_other_columns_as_attributes** – Load additional columns from a csv file as node attributes
- **include_columns** – A list of columns that should be added as node attributes from the csv file. To be used in conjunction with load_other_columns_as_attributes.
- **exclude_columns** – A list of columns that should be ignored as attributes when load_other_columns_as_attributes is enabled. This cannot be combined with include_columns
- **default_population** – Default population. Only used if population_column_name does not exist
- **nodeid_column_name** – Column name to load nodeid values from
- **latitude_column_name** – Column name to load latitude values from
- **longitude_column_name** – Column name to load longitude values from
- **population_column_name** – Column name to load population values from

Returns demographics file as a dictionary

emod_api.demographics.DemographicsGenerator.**from_file**(*population_input_file: str*, *demographics_filename: Optional[str] = None*, *concerns: Optional[Union[emod_api.dtk_tools.demographics.DemographicsC List[emod_api.dtk_tools.demographics.DemographicsGenerator = None*, *res_in_arcsec='custom'*, *node_id_from_lat_long=True*, *default_population: int = 1000*, *load_other_columns_as_attributes=False*, *include_columns: Optional[List[str]] = None*, *exclude_columns: Optional[List[str]] = None*, *nodeid_column_name: Optional[str] = None*, *latitude_column_name: str = 'lat'*, *longitude_column_name: str = 'lon'*, *population_column_name: str = 'pop'*)

Generates a demographics file from a CSV population

Parameters

- **population_input_file** – CSV population file. Must contain all the columns specified by latitude_column_name, longitude_column_name. The population_column_name is optional. If not found, we fall back to default_population
- **demographics_filename** – demographics file to save the demographics file too. This is optional

- **concerns** (*Optional[DemographicsNodeGeneratorConcern]*) – What DemographicsNodeGeneratorConcern should
- **DefaultWorldBankEquilibriumConcern** (*we apply. If not specified, we use the*) –
- **res_in_arcsec** – Resolution in Arcseconds
- **node_id_from_lat_long** – Determine if we should calculate the node id from the lat long. By default this is true unless you also set res_in_arcsec to CUSTOM_RESOLUTION. When not using lat/long for ids, the first fallback it to check the node for a forced id. If that is not found, we assign it an index as id
- **load_other_columns_as_attributes** – Load additional columns from a csv file as node attributes
- **include_columns** – A list of columns that should be added as node attributes from the csv file. To be used in conjunction with load_other_columns_as_attributes.
- **exclude_columns** – A list of columns that should be ignored as attributes when load_other_columns_as_attributes is enabled. This cannot be combined with include_columns
- **default_population** – Default population. Only used if population_column_name does not exist
- **nodeid_column_name** – Column name to load nodeid values from
- **latitude_column_name** – Column name to load latitude values from
- **longitude_column_name** – Column name to load longitude values from
- **population_column_name** – Column name to load population values from

Returns demographics file as a dictionary

emod_api.demographics.DemographicsInputDataParsers module

This file contains functions used to read, parse, and process input data files and convert the data into Nodes. Plus utility support function that are part of that process. There is no fixed fileformat for the incoming data. Any file format that is supported by a function here is a supported format. You can add to this.

emod_api.demographics.DemographicsInputDataParsers.**node_ID_from_lat_long**(*lat*, *long*, *res=0.008333333333333333*)

emod_api.demographics.DemographicsInputDataParsers.**duplicate_nodeID_check**(*nodelist*)

emod_api.demographics.DemographicsInputDataParsers.**fill_nodes_legacy**(*node_info*, *DemoDf*, *res=0.008333333333333333*)

emod_api.demographics.DemographicsInputDataParsers.**ConstructNodesFromDataFrame**(*node_info*, *extra_data_columns=[]*, *res=0.008333333333333333*)

emod_api.demographics.DemographicsTemplates module

class emod_api.demographics.DemographicsTemplates.**CrudeRate**(*init_rate*)
Bases: object

get_dtk_rate()

class emod_api.demographics.DemographicsTemplates.**YearlyRate**(*init_rate*)
Bases: *emod_api.demographics.DemographicsTemplates.CrudeRate*

class emod_api.demographics.DemographicsTemplates.**DtkRate**(*init_rate*)
Bases: *emod_api.demographics.DemographicsTemplates.CrudeRate*

emod_api.demographics.DemographicsTemplates.**NoRisk**()
NoRisk puts everyone at 0 risk.

emod_api.demographics.DemographicsTemplates.**FullRisk**(*demog*, *description=''*)
FullRisk puts everyone at 100% risk.

emod_api.demographics.DemographicsTemplates.**InitRiskUniform**(*demog*, *min_lim=0*, *max_lim=1*, *description=''*)
InitRiskUniform puts everyone at somewhere between 0% risk and 100% risk, drawn uniformly.

Parameters

- **min** (*float*) – Low end of uniform distribution. Must be >=0, <1.
- **max** (*float*) – High end of uniform distribution. Must be >=min, <=1.
- **description** – Why were these values chosen?

Returns json object aka python dict that can be directly passed to Demographics::SetDefaultFromTemplate

Raises **None** –

emod_api.demographics.DemographicsTemplates.**InitRiskLogNormal**(*demog*, *mean=0.0*, *sigma=1.0*)
InitRiskLogNormal puts everyone at somewhere between 0% risk and 100% risk, drawn from LogNormal.

Parameters

- **mean** (*float*) – Mean of lognormal distribution.
- **sigma** (*float*) – Sigma of lognormal distribution.

Returns json object aka python dict that can be directly passed to Demographics::SetDefaultFromTemplate

Raises **None** –

emod_api.demographics.DemographicsTemplates.**InitRiskExponential**(*demog*, *mean=1.0*)
InitRiskExponential puts everyone at somewhere between 0% risk and 100% risk, drawn from Exponential.

Parameters **mean** (*float*) – Mean of exponential distribution.

Returns json object aka python dict that can be directly passed to Demographics::SetDefaultFromTemplate

Raises **None** –

emod_api.demographics.DemographicsTemplates.**NoInitialPrevalence**(*demog*)
NoInitialPrevalence disables initial prevalence; outbreak seeding must be done from an Outbreak intervention (or serialized population).

Parameters **demog** – emod-api.demographics.Demographics instance.

Returns None

Raises **None** –

emod_api.demographics.DemographicsTemplates.**InitPrevUniform**(*demog*, *low_prev*, *high_prev*, *description=''*)

emod_api.demographics.DemographicsTemplates.**InitSusceptConstant**(*demog*)

emod_api.demographics.DemographicsTemplates.**EveryoneInitiallySusceptible**(*demog*, *setting=1.0*)

emod_api.demographics.DemographicsTemplates.**StepFunctionSusceptibility**(*demog*, *protected_setting=0.0*, *threshold_age=1825.0*)

emod_api.demographics.DemographicsTemplates.**SimpleSusceptibilityDistribution**(*demog*, *meanAgeAtInfection=2.5*)

emod_api.demographics.DemographicsTemplates.**DefaultSusceptibilityDistribution**(*demog*)

emod_api.demographics.DemographicsTemplates.**MortalityRateByAge**(*demog*, *age_bins*, *mort_rates*)
Set (non-disease) mortality rates by age bins. No checks are done on input arrays.

Parameters

- **age_bins** – list of age bins, with ages in years.
- **mort_rates** – list of mortality rates, where mortality rate is daily probability of dying..

Returns N/A.

emod_api.demographics.DemographicsTemplates.**MortalityStructureNigeriaDHS**(*demog*)

emod_api.demographics.DemographicsTemplates.**get_fert_dist_from_rates**(*rates*)
Create dictionary with DTK-compatible distributions from input vectors of fertility (crude) rates.

Parameters **rates** – Array/vector of crude rates for whole population, for a range of years.

emod_api.demographics.DemographicsTemplates.**get_fert_dist**(*path_to_csv*)
This function takes a fertility csv file (by year and age bin) and populates a DTK demographics.json file, and the corresponding config file to do individual pregnancies by age and year from data.

Parameters

- **demog** – emod_api.demographics.Demographics instance.
- **path_to_csv** – absolute path to csv input file. The file should have columns for 5-year age bins
- **"1950-1955".** (*labelled "15-19", etc. up to "45-49", and a column named "Years" with values like*) –
- **anywhere.** (*There can be extra columns and the columns can be*) –

Returns (complex) dictionary. fertility distribution, ready to be added to demographics file.

emod_api.demographics.DemographicsTemplates.**InitAgeUniform**(*demog*)

emod_api.demographics.DemographicsTemplates.**AgeStructureUNWPP**(*demog*)

emod_api.demographics.Node module

class emod_api.demographics.Node.**Node**(*lat*, *lon*, *pop*, *name: Optional[str] = None*, *area: Optional[float] = None*, *forced_id: Optional[int] = None*, *individual_attributes: Optional[*emod_api.demographics.PropertiesAndAttributes.IndividualAttributes*] = None*, *individual_properties: Optional[*emod_api.demographics.PropertiesAndAttributes.IndividualProperties*] = None*, *node_attributes: Optional[*emod_api.demographics.PropertiesAndAttributes.NodeAttributes*] = None*, *meta: Optional[dict] = None*)

Bases: *emod_api.demographics.Updateable.Updateable*

default_population = 1000

res_in_degrees = 0.041666666666666664

to_dict() → dict

to_tuple()

property id

classmethod init_resolution_from_file(*fn*)

classmethod from_data(*data: dict*)

Function used to create the node object from data (most likely coming from a demographics file) :param data: :return:

property pop

property lon

property lat

property birth_rate

class emod_api.demographics.Node.**OverlayNode**(*node_id*, *latitude=None*, *longitude=None*, *initial_population=None*, ***kwargs*)

Bases: *emod_api.demographics.Node.Node*

Node that only requires an ID. Use to overlay a Node.

emod_api.demographics.Node.**get_xpix_ypix**(*nodeid*)

emod_api.demographics.Node.**lat_lon_from_nodeid**(*nodeid*, *res_in_deg=0.041666666666666664*)

emod_api.demographics.Node.**xpix_ypix_from_lat_lon**(*lat*, *lon*, *res_in_deg=0.041666666666666664*)

emod_api.demographics.Node.**nodeid_from_lat_lon**(*lat*, *lon*, *res_in_deg=0.041666666666666664*)

emod_api.demographics.Node.**nodes_for_DTK**(*filename*, *nodes*)

emod_api.demographics.Node.**basicNode**(*lat: float = 0*, *lon: float = 0*, *pop: int = 1000000*, *name: str = 'node_name'*, *forced_id: int = 1*)

emod_api.demographics.PreDefinedDistributions module

class emod_api.demographics.PreDefinedDistributions.**ConstantDistribution**(*distribution*)

Bases: object

Wrapping this class around a Distributions disables __setattr__ and makes the wrapped objects constant.

to_dict()

Calls the to_dict() method of the wrapped distribution.

copy()

Creates a deepcopy of the wrapped Distribution object.

emod_api.demographics.PropertiesAndAttributes module

class emod_api.demographics.PropertiesAndAttributes.**IndividualProperty**(*initial_distribution: Optional[List[float]] = None*, *property=None*, *values: Optional[List[float]] = None*, *transitions: Optional[List[float]] = None*, *transmission_matrix: Optional[List[float]] = None*)

Bases: *emod_api.demographics.Updateable.Updateable*

to_dict() → dict

class emod_api.demographics.PropertiesAndAttributes.**IndividualProperties**(*individual_property: Optional[*emod_api.demographics.Properti *= None*)

Bases: *emod_api.demographics.Updateable.Updateable*

add(*individual_property*)

add_parameter(*key*, *value*)

Adds a user defined key-value pair to demographics. :param key: Key :param value: Value :return: None

to_dict() → dict

class emod_api.demographics.PropertiesAndAttributes.**IndividualAttributes**(*age_distribution_flag=None*, *age_distribution1=None*, *age_distribution2=None*, *age_distribution=None*, *prevalence_distribution_flag=None*, *prevalence_distribution1=None*, *prevalence_distribution2=None*, *immunity_distribution_flag=None*, *immunity_distribution1=None*, *immunity_distribution2=None*, *risk_distribution_flag=None*, *risk_distribution1=None*, *risk_distribution2=None*, *migration_heterogeneity_distribution_flag=N*, *migration_heterogeneity_distribution1=None*, *migration_heterogeneity_distribution2=None*, *fertility_distribution=None*, *mortality_distribution=None*, *mortality_distribution_male=None*, *mortality_distribution_female=None*, *susceptibility_distribution=None*)

Bases: *emod_api.demographics.Updateable.Updateable*

class **SusceptibilityDistribution**(*distribution_values: Optional[List[float]] = None*, *result_scale_factor=None*, *result_values=None*)

Bases: *emod_api.demographics.Updateable.Updateable*

to_dict() → dict

class **AgeDistribution**(*distribution_values=None*, *result_scale_factor=None*, *result_values=None*)

Bases: *emod_api.demographics.Updateable.Updateable*

to_dict() → dict

from_dict(*age_distribution: dict*)

class **FertilityDistribution**(*axis_names: Optional[List[str]] = None*, *axis_scale_factors: Optional[List[float]] = None*, *axis_units=None*, *num_distribution_axes=None*, *num_population_axes=None*, *num_population_groups=None*, *population_groups=None*, *result_scale_factor=None*, *result_units=None*, *result_values=None*)

Bases: *emod_api.demographics.Updateable.Updateable*

to_dict() → dict

from_dict(*fertility_distribution: dict*)

class MortalityDistribution(*axis_names: Optional[List[str]] = None*, *axis_scale_factors: Optional[List[float]] = None*, *axis_units=None*, *num_distribution_axes=None*, *num_population_axes=None*, *num_population_groups=None*, *population_groups=None*, *result_scale_factor=None*, *result_units=None*, *result_values=None*)

Bases: emod_api.demographics.Updateable.Updateable

to_dict() → dict

from_dict(*mortality_distribution: dict*)

to_dict() → dict

from_dict(*individual_attributes: dict*)

class emod_api.demographics.PropertiesAndAttributes.NodeAttributes(*airport: Optional[int] = None*, *altitude=None*, *area: Optional[float] = None*, *birth_rate: Optional[float] = None*, *country=None*, *growth_rate: Optional[float] = None*, *name: Optional[str] = None*, *latitude: Optional[float] = None*, *longitude: Optional[float] = None*, *metadata: Optional[dict] = None*, *initial_population: Optional[int] = None*, *region: Optional[int] = None*, *seaport: Optional[int] = None*, *larval_habitat_multiplier: Optional[List[float]] = None*, *initial_vectors_per_species=None*, *infectivity_multiplier: Optional[float] = None*, *extra_attributes: Optional[dict] = None*)

Bases: emod_api.demographics.Updateable.Updateable

from_dict(*node_attributes: dict*)

to_dict() → dict

emod_api.demographics.Updateable module

class emod_api.demographics.Updateable.**Updateable**
Bases: object

(Base) class that provides update() method for each class that inherits from this class.

to_dict() → dict

update(*overlay_object*)
Updates an object with the values from overlay_object. :param overlay_object: Object that is used to update self :return: None

add_parameter(*key*, *value*)
Adds a user defined key-value pair to demographics. :param key: Key :param value: Value :return: None

emod_api.demographics.demographics_utils module

emod_api.demographics.demographics_utils.**set_risk_mod**(*filename*, *distribution*, *par1*, *par2*)
Set the RiskDistributionFlag, RiskDistribution1 and RiskDistribution2 in a demographics file.

Parameters

- **filename** – The demographics file location
- **distribution** – The selected distribution (need to come from distribution_types)
- **par1** – Parameter 1 of the distribution
- **par2** – Parameter 2 of the distribution (may be unused depending on the selected distribution)

Returns Nothing

emod_api.demographics.demographics_utils.**set_immune_mod**(*filename*, *distribution*, *par1*, *par2*)
Set the ImmunityDistributionFlag, ImmunityDistribution1 and ImmunityDistribution2 in a demographics file.

Parameters

- **filename** – The demographics file location
- **distribution** – The selected distribution (need to come from *distribution_types*)
- **par1** – Parameter 1 of the distribution
- **par2** – Parameter 2 of the distribution (may be unused depending on the selected distribution)

Returns Nothing

emod_api.demographics.demographics_utils.**apply_to_defaults_or_nodes**(*demog*, *fn*, **args*)
Apply the fn function either to the Defaults dictionary or to each of the nodes depending if the IndividualAttributes parameter is present in the Defaults or not.

Parameters

- **demog** – The demographic file represented as a dictionary
- **fn** – The function to apply the Defaults or individual nodes
- **args** – Argument list needed by fn

Returns Nothing

emod_api.demographics.demographics_utils.**set_demog_distributions**(*filename*, *distributions*)

Apply distributions to a given demographics file. The distributions needs to be formatted as a list of (name, distribution, par1, par2) with:

- **name:** Immunity, Risk, Age, Prevalence or MigrationHeterogeneity
- **distribution:** One distribution contained in `distribution_types`
- **par1, par2:** the values for the distribution parameters

```
# Set the PrevalenceDistribution to a uniform distribution with 0.1 and 0.2
# and the ImmunityDistributionFlag to a constant distribution with 1
demog = json.load(open("demographics.json","r"))
distributions = list()
distributions.add(("Prevalence","UNIFORM_DISTRIBUTION",0.1,0.2))
distributions.add(("Immunity","CONSTANT_DISTRIBUTION",1,0))
set_demog_distribution(demog, distributions)
```

Parameters

- **filename** – the demographics file as json
- **distributions** – the different distributions to set contained in a list

Returns Nothing

emod_api.demographics.demographics_utils.**set_static_demographics**(*cb*, *use_existing=False*)

Create a static demographics based on the demographics file specified in the config file of the `DTKConfigBuilder` object passed to the function.

This function takes the current demographics file and adjust the birth rate/death rate to get a static population (the deaths are always compensated by new births).

Parameters

- **cb** – The config builder object
- **use_existing** – If `True` will only take the demographics file name and add the .static to it. If `False` will create a static demographics file based on the specified demographics file.

Returns Nothing

emod_api.demographics.demographics_utils.**set_growing_demographics**(*cb*, *use_existing=False*)

This function creates a growing population. It works the same way as the *set_static_demographics* but with a birth rate more important than the death rate which leads to a growing population.

Parameters

- **cb** – The `DTKConfigBuilder` object
- **use_existing** – If `True` will only take the demographics file name and add the .growing to it. If `False` will create a growing demographics file based on the specified demographics file.

Returns Nothing

emod_api.demographics.grid_construction module

- construct a grid from a bounding box
- label a collection of points by grid cells
- input: - points csv file with required columns lat,lon # see example input files (structures_households.csv)
- **output: - csv file of grid locations**
  - csv with grid cell id added for each point record

emod_api.demographics.grid_construction.**get_grid_cell_id**(*idx*, *idy*)

emod_api.demographics.grid_construction.**construct**(*x_min*, *y_min*, *x_max*, *y_max*)
Creating grid

emod_api.demographics.grid_construction.**get_bbox**(*data*)

emod_api.demographics.grid_construction.**lon_lat_2_point**(*lon*, *lat*)

emod_api.demographics.grid_construction.**point_2_grid_cell_id_lookup**(*point*, *grid_id_2_cell_id*, *origin*)

emod_api.interventions package

Submodules

emod_api.interventions.ccdl module

Proto-schema

WHEN :: WHERE :: WHO :: WHAT

WHEN: <Start_Time>-<End_Time> OR <Start_Time>(x<Repetitions>/<Time_BetweenReps>)

WHERE: AllPlaces OR Node_List

WHO: <Coverage%>/<IP>/<Min_Age>/<Max_Age>/<Sex>

WHAT: <Triggers>-><Intervention_Name1(Payload)>+<Intervention_Name2(Payload)>+…

emod_api.interventions.ccdl_viz module

Early draft of a very handy utility that takes a CCDL file (Concise Campaign Definition Language) and creates a graph(viz) visualization of it.

emod_api.interventions.ccdl_viz.**get_nickname_from_event**(*event_num*, *pieces*)
Allow nodes to get briefer and potentially more helpful nicknames. Default will probably remain a the nasty autogen above. Users can override this function with a callback of their own.

emod_api.interventions.ccdl_viz.**get_colour_from_event**(*tokens*)
Allow nodes to get a content-dependent colour. Default to just white. Users can override this function with a callback of their own. Have been using colour to capture IP categories.

emod_api.interventions.ccdl_viz.**get_shape_from_event**(*tokens*)
Allow nodes to get a content-dependent shape. Default to circle. Users can override this function with a callback of their own. Have been using shape to capture 'epoch' categories. Possible shapes include ellipse, circle, square, and diamond. Full list can be found at: https://www.graphviz.org/doc/info/shapes.html

emod_api.interventions.ccdl_viz.**set_beautifiers**(*name_cb=None*, *colour_cb=None*, *shape_cb=None*)
Override default no-op callbacks for setting nicknames, colours, and shapes of campaign nodes

emod_api.interventions.ccdl_viz.**viz**(*in_name='campaign.ccdl'*, *out_name='camp.sv'*, *display=True*, *whitelist=None*)

emod_api.interventions.common module

emod_api.interventions.common.**BroadcastEvent**(*camp*, *Event_Trigger: str = 'Births'*)
Wrapper function to create and return a BroadcastEvent intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Event_Trigger** – A valid trigger/event/signal.

Returns Schema-based smart dictionary representing a new BroadastEvent intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**BroadcastEventToOtherNodes**(*camp*, *Event_Trigger*, *Node_Selection_Type='DISTANCE_ONLY'*, *Max_Distance_To_Other_Nodes_Km=- 1*, *Include_My_Node=1*)
Wrapper function to create and return a BroadcastEventToOtherNodes intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Event_Trigger** – A valid trigger/event/signal.
- **Node_Selection_Type** – TBD.
- **Max_Distance_To_Other_Nodes_Km** – TBD.
- **Include_My_Node** – TBD.

Returns Schema-based smart dictionary representing a new BroadastEvent intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**MultiInterventionDistributor**(*camp*, *Intervention_List*)
Wrapper function to create and return a MultiInterventionDistributor intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Intervention_List** – List of 1 or more valid intervention dictionaries to be
- **together.** (*distributed*) –

Returns Schema-based smart dictionary representing a new MultiInterventionDistributor intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**DelayedIntervention**(*camp*, *Configs*, *Delay_Dict=None*)
Wrapper function to create and return a DelayedIntervention intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Config** – Valid intervention config.
- **Delay_Dict** – Dictionary of 1 or 2 params that are the literal Delay_Distribution
- **E.g.,** (*parameters, but without the distribution, which is inferred.*) –
- **"Delay_Period_Exponential"** ({) – 5 }

Returns Schema-based smart dictionary representing a new DelayedIntervention intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**HSB**(*camp*, *Event_Or_Config='Event'*, *Config=None*, *Event='NoTrigger'*, *Tendency=1.0*, *Single_Use=True*, *Name='HSB'*)

Wrapper function to create and return a HealthSeekingBehaviour intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Event_Or_Config** – "Event" or "Config".
- **Config** – Complete, valid intervention configuration to be distributed.
- **Event** – Event/Trigger/Signal to be broadcast, alternative to an intervention.
- **Tendency** – Daily probability of 'seeking care' aka distributing payload intervention.
- **Single_Use** – One-and-done, or continuous?
- **Name** – Intervention Name. Useful if you want to provide uniqueness and not worry about
- **management.** (*duplicate intervention*) –

Returns Schema-based smart dictionary representing a new HSB intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**NLHTI**(*camp*, *Triggers*, *Interventions*, *Property_Restrictions=None*, *Demographic_Coverage=1.0*, *Target_Age_Min=0*, *Target_Age_Max=45625*, *Target_Gender='All'*, *Target_Residents_Only=False*, *Duration=- 1*, *Blackout_Event_Trigger=None*, *Blackout_Period=None*, *Blackout_On_First_Occurrence=None*, *Disqualifying_Properties=None*)

Wrapper function to create and return a NodeLevelHealthTriggeredIntervention intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Triggers** – List of Triggers/Events/Signals
- **Interventions** – List of interventions to distrbute when signal is heard.
- **Property_Restrictions** – Individual Properties that an agent must have to qualify for intervention.
- **Demographic_Coverage** – Percentage of individuals to receive intervention.
- **Target_Age_Min** – Minimum age (in years).
- **Target_Age_Max** – Maximum age (in years).

- **Target_Gender** – All, Male, or Female.
- **Target_Residents_Only** – Not used.
- **Duration** – How long this listen-and-distribute should last.
- **Blackout_Event_Trigger** – Not used.
- **Blackout_Period** – Not used.
- **Blackout_On_First_Occurrence** – Not used.
- **Disqualifying_Properties** – Not used.

Returns Schema-based smart dictionary representing a new NLHTI intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**PropertyValueChanger**(*camp*, *Target_Property_Key*, *Target_Property_Value*, *Daily_Probability=1.0*, *Maximum_Duration=1*, *Revert=- 1*, *Intervention_Name=''*, *Event_Trigger_Distributed=''*, *Event_Trigger_Expired=''*)

Wrapper function to create and return a PropertyValueChanger intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **IP.** (*Target_Property_Value. The value part of the new key-value pair of the*) –
- **IP.** –
- **key** (*New_Property_Value.. Optional IP*) – value part to be set, common to all interventions.
- **Target_Property_Value.** (*Daily_Probability. The daily probability that an individual will move to the*) –
- **Daily_Probability.** (*Maximum_Duration. The maximum amount of time individuals have to move to a new group. This timing works in conjunction with*) –
- **group.** (*Revert. The number of days before an individual moves back to their original*) –
- **policy.** (*Intervention_Name. Optional Intervention_Name. Useful if managing a replacement*) –
- **distributed.** (*Event_Trigger_Distributed. Optional broadcast trigger to be published when PVC is*) –
- **expired.** (*Event_Trigger_Expired. Optional broadcast trigger to be published when PVC is*) –

Returns Schema-based smart dictionary representing a new PropertyValueChanger intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**ScheduledCampaignEvent**(*camp*, *Start_Day: int*, *Node_Ids=None*, *Nodeset_Config=None*, *Number_Repetitions: int = 1*, *Timesteps_Between_Repetitions: int = - 1*, *Event_Name: str = 'Scheduled_Campaign_Event'*, *Property_Restrictions=None*, *Demographic_Coverage: float = 1.0*, *Target_Age_Min=0*, *Target_Age_Max=45625*, *Target_Gender: str = 'All'*, *Target_Residents_Only: bool = False*, *Intervention_List=None*)

Wrapper function to create and return a ScheduledCampaignEvent intervention. The alternative to a ScheduledCampaignEvent is a TriggeredCampaignEvent.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Start_Day** – When to start.
- **Event_Name** – Name for overall campaign event, of no functional meaning. Not in schema and not yet used.
- **Node_Ids** – Nodes to target with this intervenion
- **Nodeset_Config** – Nodes to target with this intervenion, return from utils.do_nodes().

  Deprecated since version 2.x: Use parameter Node_Ids instead
- **Property_Restrictions** – Individual Properties a person must have to receive the intervention(s).
- **Number_Repetitions** – N/A
- **Timesteps_Between_Repetitions** – N/A
- **Demographic_Coverage** – Percentage of individuals to receive intervention.
- **Target_Age_Min** – Minimum age (in years).
- **Target_Age_Max** – Maximum age (in years).
- **Target_Gender** – All, Male, or Female.
- **Intervention_List** – List of 1 or more valid intervention dictionaries to be
- **together.** (*distributed*) –

Returns Schema-based smart dictionary representing a new ScheduledCampaignEvent intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**TriggeredCampaignEvent**(*camp*, *Start_Day: int*, *Event_Name: str*, *Triggers: List[str]*, *Intervention_List: List[dict]*, *Node_Ids=None*, *Nodeset_Config=None*, *Node_Property_Restrictions=None*, *Property_Restrictions=None*, *Number_Repetitions: int = 1*, *Timesteps_Between_Repetitions: int = - 1*, *Demographic_Coverage: float = 1.0*, *Target_Age_Min=0*, *Target_Age_Max=45625*, *Target_Gender: str = 'All'*, *Target_Residents_Only=False*, *Duration=- 1*, *Blackout_Event_Trigger: Optional[str] = None*, *Blackout_Period=0*, *Blackout_On_First_Occurrence=0*, *Disqualifying_Properties=None*, *Delay=None*)

Wrapper function to create and return a TriggeredCampaignEvent intervention. The alternative to a TriggeredCampaignEvent is a ScheduledCampaignEvent.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Start_Day** – When to start.
- **Event_Name** – Name for overall campaign event, of no functional meaning. Not in schema and not yet used.
- **Node_Ids** – Nodes to target with this intervenion
- **Nodeset_Config** – Nodes to target with this intervenion, return from utils.do_nodes().

  Deprecated since version 2.x: Use parameter Node_Ids instead
- **Triggers** – List of triggers/events/signals to listen to in order to trigger distribution.
- **Intervention_List** – List of 1 or more valid intervention dictionaries to be
- **together.** (*distributed*) –
- **Node_Property_Restrictions** – N/A.
- **Property_Restrictions** – Individual Properties a person must have to receive the intervention(s).
- **Demographic_Coverage** – Percentage of individuals to receive intervention.
- **Target_Age_Min** – Minimum age (in years).
- **Target_Age_Max** – Maximum age (in years).
- **Target_Gender** – All, Male, or Female.
- **Target_Residents_Only** – TBD.
- **Duration** – How long this listen-and-distribute should last.
- **Blackout_Event_Trigger** – Not used.
- **Blackout_Period** – Not used.
- **Blackout_On_First_Occurrence** – Not used.
- **Disqualifying_Properties** – Not used.

- **delay** – Optional delay between trigger and actual distribution.

Returns Schema-based smart dictionary representing a new TriggeredCampaignEvent intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**StandardDiagnostic**(*camp*, *Base_Sensitivity: float = 1.0*, *Base_Specificity: float = 1.0*, *Days_To_Diagnosis: float = 0.0*, *Event_Trigger_Distributed: Optional[str] = None*, *Event_Trigger_Expired: Optional[str] = None*, *Positive_Diagnosis_Intervention=None*, *Positive_Diagnosis_Event: str = 'PositiveResult'*, *Negative_Diagnosis_Intervention=None*, *Negative_Diagnosis_Event: str = 'NegativeResult'*, *Treatment_Fraction: float = 1.0*)

Wrapper function to create and return a StandardDiagnostic intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **Base_Sensitivity** – base sensitivity [0..1]
- **Base_Specificity** – base specificity [0..1]
- **Days_To_Diagnosis** – days to diagnosis
- **Event_Trigger_Distributed** – A trigger that is fired when intervention was distributed
- **Event_Trigger_Expired** – A trigger that is fired when intervention has expired
- **Positive_Diagnosis_Intervention** – Intervention that is distributed in case of a positive diagnosis. If set, no events may be configured.
- **Positive_Diagnosis_Event** – A trigger that is fired in case of a positive diagnosis
- **Negative_Diagnosis_Intervention** – Intervention that is distributed in case of a Negative diagnosis. If set, no events may be configured. Not used outside of Malaria-Ongoing yet.
- **Negative_Diagnosis_Event** – A trigger that is fired in case of a Negative diagnosis. Not used outside of Malaria-Ongoing yet.
- **Treatment_Fraction** – treatment fraction [0..1]

Returns Schema-based smart dictionary representing a new MultiInterventionDistributor intervention ready to be added to a campaign.

Return type *ReadOnlyDict*

emod_api.interventions.common.**triggered_campaign_delay_event**(*camp*, *start_day*, *trigger*, *delay*, *intervention*, *ip_targeting=[]*, *coverage=1.0*)

Create and return a campaign event that responds to a trigger after a delay with an intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **start_day** – When to start.
- **delay** – Dictionary of 1 or 2 params that are the literal Delay_Distribution parameters,

- **"Delay_Period_Exponential"** (*but without the distribution, which is inferred. E.g., {*) – 5 }.
- **trigger** – E.g., "NewInfection".
- **intervention** – List of 1 or more valid intervention dictionaries to be distributed together.
- **ip_targeting** – Optional Individual Properties required for someone to receive the intervntion(s).

Returns Campaign event.

emod_api.interventions.common.**triggered_campaign_event_with_optional_delay**(*camp*, *start_day*, *triggers*, *intervention*, *delay=None*, *duration=- 1*, *ip_targeting=None*, *coverage=1.0*, *target_age_min=0*, *target_age_max=45625*, *target_sex='All'*, *target_residents_only=False*, *blackout=True*, *check_at_trigger=False*)

Create and return a campaign event that responds to a trigger after a delay with an intervention.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **start_day** – When to start.
- **triggers** – List of signals to listen for/trigger on. E.g., "NewInfection".
- **intervention** – List of 1 or more valid intervention dictionaries to be distributed together.
- **delay** – Optional dictionary of 1 or 2 params that are the literal Delay_Distribution parameters,
- **"Delay_Period_Exponential"** (*but without the distribution, which is inferred. E.g., {*) – 5 }. If omitted,
- **immediate.** (*intervention is*) –
- **duration** – How long to listen.
- **ip_targeting** – Optional Individual Properties required for someone to receive the intervntion(s).
- **coverage** – Fraction of target population to reach.
- **target_age_min** – Minimum age to target.
- **target_age_max** – Maximum age to target.
- **target_sex** – Optional target just "MALE" or "FEMALE" individuals.
- **target_residents_only** – Set to True to target only the individuals who started the simulation in this node and are still in the node.

- **blackout** – Set to True if you don't want the triggered intervention to be distributed to the same person more than once a day.
- **check_at_trigger** – if triggered event is delayed, you have an option to check individual/node's eligibility at the initial trigger or when the event is actually distributed after delay.

Returns Campaign event.

emod_api.interventions.common.**change_individual_property_at_age**(*camp*, *new_ip_key*, *new_ip_value*, *change_age_in_days*, *revert_in_days*, *ip_targeting_key*, *ip_targeting_value*, *coverage=1.0*)

Create and return a campaign event that changes a person's Individual Properties once they turns a certain age. e.g., change_individual_property_at_age(cb, 'ForestGoing', 'LovesForest', coverage=0.6, change_age_in_days=15*365, revert=20*365)

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **new_ip_key** – The new IP key.
- **new_ip_value** – The new IP value.
- **change_age_in_days** – The age at which the individual transitions (in units of days).
- **revert_in_days** – How many days they remain with the new property.
- **ip_targeting_key** – The IP key a person must have to receive this.
- **ip_targeting_value** – The IP value a person must have to receive this.
- **coverage** – Optional fraction to limit this to a subset of the target population.

Returns Campaign event.

emod_api.interventions.common.**change_individual_property_triggered**(*camp*, *triggers: list*, *new_ip_key: str*, *new_ip_value: str*, *start_day: int = 0*, *daily_prob: float = 1*, *max_duration: int = 9.3228e+35*, *revert_in_days: int = - 1*, *node_ids: Optional[list] = None*, *ip_restrictions: Optional[list] = None*, *coverage: float = 1.0*, *target_age_min: float = 0*, *target_age_max: float = 45625*, *target_sex: str = 'All'*, *target_residents_only: bool = False*, *delay=None*, *listening_duration: int = - 1*, *blackout: bool = True*, *check_at_trigger: bool = False*)

Change Individual Properties when a certain trigger is observed.

Parameters

- **camp** – The instance containing the campaign builder and accumulator.
- **triggers** – A list of the events that will trigger the intervention.
- **new_ip_key** – The individual property key to assign to the individual. For example, InterventionStatus.
- **new_ip_value** – The individual property value to assign to the individual. For example, RecentDrug.
- **start_day** – The day on which to start distributing the intervention (**Start_Day** parameter).
- **node_ids** – The list of nodes to apply this intervention to. If not provided, defaults to all nodes.
- **daily_prob** – The daily probability that an individual's property value will be updated (**Daily_Probability** parameter).
- **max_duration** – The maximum amount of time individuals have to move to a new **daily_prob**; individuals not moved to the new value by the end of **max_duration** keep the same value.
- **revert_in_days** – The number of days before a node reverts to its original property value. Default of 0 means the new value is kept forever.
- **ip_restrictions** – The IndividualProperty key:value pairs to target.
- **coverage** – The proportion of the population that will receive the intervention (**Demographic_Coverage** parameter).
- **target_age_min** – Minimum age to target.
- **target_age_max** – Maximum age to target.
- **target_sex** – Optional target just "MALE" or "FEMALE" individuals.
- **target_residents_only** – Set to True to target only the individuals who started the simulation in this node and are still in the node.
- **delay** – The number of days the campaign is delayed after being triggered.
- **listening_duration** – The number of time steps that the triggered campaign will be active for. Default is -1, which is indefinitely.
- **blackout** (*advanced*) – Set to True if you don't want the triggered intervention to be distributed to the same person more than once a day.
- **check_at_trigger** (*advanced*) – if triggered event is delayed, you have an option to check individual/node's eligibility at the initial trigger or when the event is actually distributed after delay.
- **Returns** – N/A.

emod_api.interventions.common.**change_individual_property_scheduled**(*camp*, *new_ip_key*, *new_ip_value*, *start_day: int = 0*, *number_repetitions: int = 1*, *timesteps_between_reps: int = - 1*, *node_ids: Optional[list] = None*, *daily_prob: float = 1*, *max_duration: int = 9.3228e+35*, *revert_in_days: int = - 1*, *ip_restrictions: Optional[list] = None*, *coverage: float = 1.0*, *target_age_min: float = 0*, *target_age_max: float = 45625*, *target_sex: str = 'All'*, *target_residents_only: bool = False*)

Change Individual Properties at a given time.

Parameters

- **camp** – The instance containing the campaign builder and accumulator.
- **new_ip_key** – The individual property key to assign to the individual. For example, InterventionStatus.
- **new_ip_value** – The individual property value to assign to the individual. For example, RecentDrug.
- **start_day** – The day on which to start distributing the intervention (**Start_Day** parameter).
- **node_ids** – The list of nodes to apply this intervention to. If not provided, defaults to all nodes.
- **daily_prob** – The daily probability that an individual's property value will be updated (**Daily_Probability** parameter).
- **max_duration** – The maximum amount of time individuals have to move to a new **daily_prob**; individuals not moved to the new value by the end of **max_duration** keep the same value.
- **revert_in_days** – The number of days before an individual reverts to its original property value. Default of -1 means the new value is kept forever.
- **ip_restrictions** – The IndividualProperty key:value pairs to target.
- **coverage** – The proportion of the population that will receive the intervention (**Demographic_Coverage** parameter).
- **target_age_min** – Minimum age to target.
- **target_age_max** – Maximum age to target.
- **target_sex** – Optional target just "MALE" or "FEMALE" individuals.
- **target_residents_only** – Set to True to target only the individuals who started the simulation in this node and are still in the node.
- **Returns** – N/A.

emod_api.interventions.common.**change_individual_property**(*camp*, *target_property_name: str*, *target_property_value: str*, *start_day: int = 0*, *number_repetitions: int = 1*, *timesteps_between_reps: int = - 1*, *node_ids: Optional[list] = None*, *daily_prob: float = 1*, *max_duration: int = 9.3228e+35*, *revert: int = - 1*, *coverage: float = 1*, *ip_restrictions: Optional[list] = None*, *target_age_min: float = 0*, *target_age_max: float = 45625*, *target_sex: str = 'All'*, *target_residents_only: bool = False*, *trigger_condition_list: Optional[list] = None*, *triggered_campaign_delay: int = 0*, *listening_duration: int = - 1*, *blackout_flag: bool = True*, *check_eligibility_at_trigger: bool = False*)

Add an intervention that changes the individual property value to another on a particular day OR after a triggering event using the **PropertyValueChanger** class. Deprecated. Prefer change_individual_property_scheduled or change_individual_property_triggered depending on the use case.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **target_property_name** – The individual property key to assign to the individual. For example, Risk.
- **target_property_value** – The individual property value to assign to the individual. For example, High.
- **start_day** – The day on which to start distributing the intervention.
- **number_repetitions** – Optional repeater value. Does not work with triggers.
- **timesteps_between_reps** – Gap between repetitions, optional. Does not work with triggers.
- **node_ids** – The list of nodes to apply this intervention to. Defaults to all.
- **daily_prob** – The daily probability that an individual's property value will be updated (**Daily_Probability** parameter).
- **max_duration** – The number of days to continue the intervention after **start_day**.
- **revert** – The number of days before an individual reverts to its original property value. Default of -1 means the new value is kept forever.
- **coverage** – The proportion of the population that will receive the intervention (**Demographic_Coverage** parameter).
- **ip_restrictions** – The IndividualProperty key:value pairs to target. Usually this will be the same key but different from the target_property_xxx entries.
- **target_residents_only** – Set to True to target only the individuals who started the simulation in this node and are still in the node.
- **target_age_min** – Optional minimum age, defaults to 0.

- **target_age_max** – Optional maximum age, defaults to inf.
- **target_sex** – Optional target sex, defaults to both.
- **triggered_campaign_delay** – The number of days the campaign is delayed after being triggered.
- **trigger_condition_list** – A list of the events that will trigger the intervention. If included, **start_day** is the day when monitoring for triggers begins.
- **listening_duration** – The number of time steps that the triggered campaign will be active for. Default is -1, which is indefinitely.
- **blackout_flag** – Set to True if you don't want the triggered intervention to be distributed to the same person more than once a day.
- **check_eligibility_at_trigger** – if triggered event is delayed, you have an option to check individual/node's eligibility at the initial trigger or when the event is actually distributed after delay.

Returns None

emod_api.interventions.import_pressure module

emod_api.interventions.import_pressure.**new_intervention**(*timestep*, *durs=[]*, *dips=[]*, *nods=[]*)

emod_api.interventions.import_pressure.**new_intervention_as_file**(*timestep*, *filename=None*)

emod_api.interventions.migration module

emod_api.interventions.migration.**add_migration_event**(*camp*, *nodeto*, *start_day: int = 0*, *coverage: float = 1*, *repetitions: int = 1*, *tsteps_btwn: int = 365*, *duration_at_node: Optional[dict] = None*, *duration_before_leaving: Optional[dict] = None*, *target_age: Optional[dict] = None*, *nodes_from_ids: Optional[List[int]] = None*, *ind_property_restrictions=None*, *node_property_restrictions=None*, *triggered_campaign_delay=0*, *trigger_condition_list=None*, *listening_duration=- 1*)

Add a migration event to a campaign that moves individuals from one node to another.

Parameters

- **camp** – emod_api.campaign object with schema_path set.
- **nodeto** – The NodeID that the individuals will travel to.
- **start_day** – A day when intervention is distributed
- **coverage** – The proportion of the population covered by the intervention
- **repetitions** – The number of times to repeat the intervention
- **tsteps_btwn** – The number of time steps between repetitions.
- **duration_before_leaving** – Dictionary of parameters that define the distribution for duration before leaving node, including the distribution. Durations are in days. .. rubric:: Examples

{“Duration_Before_Leaving_Distribution”:”GAUSSIAN_DISTRIBUTION”, “Duration_Before_Leaving_Gaussian_Mean”: 14, “Duration_Before_Leaving_Gaussian_Std_Dev” 3} {“Duration_Before_Leaving_Distribution”:”POISSON_DISTRIBUTION”, “Duration_Before_Leaving_Poisson_Mean” 30}

- **duration_at_node** – Dictionary of parameters that define the distribution for duration at node, including the distribution Durations are in days. .. rubric:: Examples

  {“Duration_At_Node_Distribution”:”GAUSSIAN_DISTRIBUTION”, “Duration_At_Node_Gaussian_Mean”: 14, “Duration_At_Node_Gaussian_Std_Dev” 3} {“Duration_At_Node_Distribution”:”POISSON_DISTRIBUTION”, “Duration_At_Node_Poisson_Mean” 30}

- **target_age** – The individuals to target with the intervention. To restrict by age, provide a dictionary of {‘agemin’ : x, ‘agemax’ : y}. Default is targeting everyone.
- **nodes_from_ids** – The list of node ids to apply this intervention to.
- **ind_property_restrictions** – The IndividualProperty key:value pairs that individuals must have to receive the intervention (**Property_Restrictions_Within_Node** parameter). In the format `[{"BitingRisk":"High"}, {"IsCool":"Yes}]`.
- **node_property_restrictions** – The NodeProperty key:value pairs that nodes must have to receive the intervention. In the format `[{"Place":"RURAL"}, {"ByALake":"Yes}]`.
- **triggered_campaign_delay** – After the trigger is received, the number of time steps until distribution starts. Eligibility of people or nodes for the campaign is evaluated on the start day, not the triggered day.
- **trigger_condition_list** – A list of the events that will trigger the intervention. If included, **start_days** is then used to distribute **NodeLevelHealthTriggeredIV**.
- **listening_duration** – The number of time steps that the distributed event will monitor for triggers. Default is -1, which is indefinitely.

Returns None

Example

from emod_api import campaign as camp dan = {“Duration_At_Node_Distribution”:”POISSON_DISTRIBUTION”, “Duration_At_Node_Poisson_Mean” 30} dbl = {“Duration_Before_Leaving_Distribution”:”GAUSSIAN_DISTRIBUTION”, “Duration_Before_Leaving_Gaussian_Mean”: 14, “Duration_Before_Leaving_Gaussian_Std_Dev” 3}

add_migration_event(camp, nodeto=5, start_day=1, coverage=0.75, duration_at_node = dan, duration_before_leaving = dbl, repetitions=1, tsteps_btwn=90, target=’Everyone’, nodesfrom={“class”: “NodeSetAll”}, node_property_restrictions=[{“Place”: “Rural”}])

emod_api.interventions.node_multiplier module

`emod_api.interventions.node_multiplier.`**new_intervention**(*camp*, *new_infectivity=1.0*, *profile='CONST'*, ***kwargs*)

Create new NodeInfectivityModifying intervention.

Parameters

- **profile** – multiplier options include:
  - **CONST(ANT)**

        * new_infectivity lasts forever (or until replaced).

      - **TRAP(EZOID)**

        * rise_dur(ation)

        * peak_dur(ation)

        * fall_dur(ation)

      - **EXP(ONENTIAL) (not implemented yet)**

        * rise duration

        * rise rate

      - **SIN(USOIDAL) (not implemented yet)**

        * period

    - **durations** (*To do boxcar, specify 0 rise and fall*) –

  Returns new NodeInfectivityMult intervention dictionary.

emod_api.interventions.node_multiplier.**new_scheduled_event**(*camp*, *start_day=1*, *new_infectivity=1.0*, *profile='CONST'*, *node_ids=None*, *recurring=True*, ***kwargs*)

Create new NodeInfectivityModifying intervention as scheduled campaign event.

emod_api.interventions.node_multiplier.**new_intervention_as_file**(*camp*, *timestep*, *filename=None*)

Create new NodeInfectivityModifying intervention as sole scheduled campaign event inside working campaign json file.

emod_api.interventions.outbreak module

emod_api.interventions.outbreak.**seed**(*camp*, *Start_Day: int*, *Coverage: float*, *Target_Props=None*, *Node_Ids=None*, *Tot_Rep: int = 1*, *Rep_Interval: int = - 1*, *Target_Age_Min: float = 0*, *Target_Age_Max: float = 125*, *Target_Gender: str = 'All'*, *Honor_Immunity: bool = False*)

Distribute an outbreak (via prevalence increase of existing agents) to individuals based on inclusion criteria.

Parameters

- **camp** – Central campaign builder object.
- **Start_Day** – Simulation timestep when outbreak should occur. Required.
- **Coverage** – Fraction of population to reach. No default.
- **Target_Props** – Individual Properties to limit the seeding to.
- **Node_Ids** – Nodes to target. Optional. Defaults to all.
- **Tot_Rep** – Number of times to "re-seed". Optional. Defaults to just once.
- **Rep_Interval** – Number of timesteps between re-seeding events. Optional. Use with Rep_Num.
- **Target_Age_Min** – Minimum age in years. Optional. Defaults to 0.
- **Target_Age_Max** – Maximum age in years. Optional. Defaults to AGE_MAX.
- **Target_Gender** – Optional sex-targeting param (Male or Female if you don't want "All").

- **Honor_Immunity** – Set to True if you want to infect people regardless of their immunity.

emod_api.interventions.outbreak.**seed_by_coverage**(*campaign_builder*, *timestep*, *coverage=0.01*, *node_ids=[]*, *properties=None*, *ignore_immunity=None*, *intervention_only=False*)

This simple function provides a very common piece of functionality to seed an infection. A future version will support targeted nodesets.

emod_api.interventions.outbreak.**new_intervention**(*campaign_builder*, *timestep*, *cases=1*)

Create EMOD-ready Outbreak intervention.

Parameters

- **timestep** (*float*) – timestep at which outbreak should occur.
- **cases** (*integer*) – new parmamter that specifies maximum number of cases. May not be supported.

Returns event as dict (json)

Return type event (json)

emod_api.interventions.outbreak.**new_intervention_as_file**(*camp*, *timestep*, *cases=1*, *filename=None*)

emod_api.interventions.simple_vaccine module

emod_api.interventions.simple_vaccine.**new_intervention**(*timestep*, *v_type='Generic'*, *efficacy=1.0*, *sv_name='Vaccine'*, *waning_duration=100*, *d_a_d=None*, *cost_to_consumer=None*, *e_i_r=None*, *intervention_only=False*)

This is mostly an example but also potentially useful. With this you get a Vaccine with working defaults but 2 configurables: type and efficacy. The duration is fixet at box. You of course must specify the timestep and you can add a vaccine name which is mostly useful if you're managing a duplicate policy.

emod_api.interventions.simple_vaccine.**new_intervention2**(*timestep*)

This version lets you invoke the function sans-parameters. You get the module-level params which you can set before calling this. This is designed to support are more data-oriented way of using this API, with everything like "a.b=c", and avoid "churn" on the API itself (constantly changing function signature). TBD: Make sure that if this is called twice, we understand whether we have copies or references going on.

emod_api.interventions.simple_vaccine.**new_intervention_as_file**(*timestep*, *filename=None*)

emod_api.interventions.utils module

emod_api.interventions.utils.**do_nodes**(*schema_path*, *node_ids: Optional[list] = None*)

Create and return a NodeSetConfig based on node_ids list.

Parameters

- **schema_path** – Path to schema.json file.
- **node_ids** – a list of NodeIDs, defaults to None, which is NodeSetAll

Returns Well-configured NodeSetConfig

emod_api.interventions.utils.**get_waning_from_params**(*schema_path*, *initial=1.0*, *box_duration=365*, *decay_rate=0*, *decay_time_constant=None*)

Get well-configured waning structure. Default is 1-year full efficacy box. Note that an infinite decay rate (0 or even -1) is same as WaningEffectBox. Note that an infinite box duration (-1) is same as WaningEffectConstant. Note that a zero box duration is same as WaningEffectExponential.

Parameters

- **schema_path** – Path to schema.json file.
- **initial** – Initial_Effect value, defaults to 1.0.
- **box_duration** – Number of timesteps efficacy remains at Initial_Effect before decay. Defaults to 365.
- **decay_rate** – Rate at which Initial_Effect decays after box_duration. Defaults to 0.
- **decay_time_constant** – 1/decay_rate. Defaults to None. Use this or decay_rate, not both. If this is specified, decay_rate is ignored.

Returns

A well-configured WaningEffect structure

Deprecated since version 2.x: Please use function get_waning_from_parameters() or get_waning_from_points().

emod_api.interventions.utils.**get_waning_from_points**(*schema_path*, *initial: float = 1.0*, *times_values=None*, *expire_at_end: bool = False*)

Get well-configured waning structure.

Parameters

- **schema_path** – Path to schema.json file.
- **initial** – Initial_Effect value, defaults to 1.0.
- **times_values** – A list of tuples with days and values. The values match the defined linear values that modify the Initial_Effect, e.g. [(day_0, value_0), (day_5, value_5)].
- **expire_at_end** – Set to 1 to have efficacy go to zero and let the intervention expire when the end of the map is reached. Only vaccines and bednet usage currently support this expiration feature. defaults to 0.

Returns A well-configured WaningEffectMapLinear structure

emod_api.interventions.utils.**get_waning_from_parameters**(*schema_path*, *initial: float = 1.0*, *box_duration: float = 365*, *decay_rate: float = 0*, *decay_time_constant: Optional[float] = None*)

Get well-configured waning structure. Default is 1-year full efficacy box. Note that an infinite decay rate (0 or even -1) is same as WaningEffectBox. Note that an infinite box duration (-1) is same as WaningEffectConstant. Note that a zero box duration is same as WaningEffectExponential.

Parameters

- **schema_path** – Path to schema.json file.
- **initial** – Initial_Effect value, defaults to 1.0.

- **box_duration** – Number of timesteps efficacy remains at Initial_Effect before decay. Defaults to 365.
- **decay_rate** – Rate at which Initial_Effect decays after box_duration. Defaults to 0.
- **decay_time_constant** – 1/decay_rate. Defaults to None. Use this or decay_rate, not both. If this is specified, decay_rate is ignored.

Returns A well-configured WaningEffect structure

emod_api.migration package

Subpackages

emod_api.migration.client package

Submodules

emod_api.migration.client.client module

emod_api.migration.client.client.**run**(*input_file: pathlib.Path*, *parameters: dict*) → None
Run a client that tries to connect the url given in parameters. The client will do a Post operation with the parameters given in parameters.

Parameters

- **input_file** – Path to the demographics file.
- **parameters** – Dictionary containing the server url and the parameters for model calculation.

Submodules

emod_api.migration.migration module

class emod_api.migration.migration.**Layer**
Bases: dict

The Layer object represents a mapping from source node (IDs) to destination node (IDs) for a particular age, gender, age+gender combination, or all users if no age or gender dependence. Users will not generally interact directly with Layer objects.

property DatavalueCount: int
Get (maximum) number of data values for any node in this layer

Returns Maximum number of data values for any node in this layer

property NodeCount: int
Get the number of (source) nodes with rates in this layer

Returns Number of (source) nodes with rates in this layer

class emod_api.migration.migration.**Migration**
Bases: object

Represents migration data in a mapping from source node (IDs) to destination node (IDs) with rates for each pairing.

Migration data may be age dependent, gender dependent, both, or the same for all ages and genders. A migration file (along with JSON metadata) can be loaded from the static method Migration.from_file() and inspected and/or modified. Migration objects can be started from scratch with Migration(), and populated with appropriate source-dest rate data and saved to a file with the to_file() method. Given migration = Migration(), syntax is as follows:

age and gender agnostic: migration[source_id][dest_id] age dependent: migration[source_id:age] # age should be >= 0, ages > last bucket value use last bucket value gender dependent: migration[source_id:gender] # gender one of Migration.MALE or Migration.FEMALE age and gender dependent: migration[source_id:gender:age] # gender one of Migration.MALE or Migration.FEMALE

EMOD/DTK format migration files (and associated metadata files) can be written with migration.to_file(<filename>). EMOD/DTK format migration files (with associated metadata files) can be read with migration.from_file(<filename>).

SAME_FOR_BOTH_GENDERS = 0

ONE_FOR_EACH_GENDER = 1

LINEAR_INTERPOLATION = 0

PIECEWISE_CONSTANT = 1

LOCAL = 1

AIR = 2

REGIONAL = 3

SEA = 4

FAMILY = 5

INTERVENTION = 6

IDREF_LEGACY = 'Legacy'

IDREF_GRUMP30ARCSEC = 'Gridded world grump30arcsec'

IDREF_GRUMP2PT5ARCMIN = 'Gridded world grump2.5arcmin'

IDREF_GRUMP1DEGREE = 'Gridded world grump1degree'

MALE = 0

FEMALE = 1

MAX_AGE = 125

property AgesYears: list
List of ages - ages < first value use first bucket, ages > last value use last bucket.

property Author: str
str: Author value for metadata for this migration datafile

property DatavalueCount: int
int: Maximum data value count for any layer in this migration datafile

property DateCreated: datetime.datetime
datetime: date/time stamp of this datafile

property GenderDataType: int
int: gender data type for this datafile - SAME_FOR_BOTH_GENDERS or ONE_FOR_EACH_GENDER

property IdReference: str
str: ID reference metadata value

property **InterpolationType**: int
int: interpolation type for this migration data file - LINEAR_INTERPOLATION or PIECEWISE_CONSTANT

property **MigrationType**: int
int: migration type for this migration data file - LOCAL | AIR | REGIONAL | SEA | FAMILY | INTERVENTION

property **Nodes**: list

property **NodeCount**: int
int: maximum number of source nodes in any layer of this migration data file

get_node_offsets(*limit: int = 100*) → dict

property **NodeOffsets**: dict
dict: mapping from source node id to offset to destination and rate data in binary data

property **Tool**: str
str: tool metadata value

to_file(*binaryfile: pathlib.Path*, *metafile: Optional[pathlib.Path] = None*, *value_limit: int = 100*)
Write current data to given file (and .json metadata file)

Parameters

- **binaryfile** (*Path*) – path to output file (metadata will be written to same path with ".json" appended)
- **metafile** (*Path*) – override standard metadata file naming
- **value_limit** (*int*) – limit on number of destination values to write for each source node (default = 100)

Returns path to binary file

Return type (Path)

emod_api.migration.migration.**from_file**(*binaryfile: pathlib.Path*, *metafile: Optional[pathlib.Path] = None*)
Reads migration data file from given binary (and associated JSON metadata file)

Parameters

- **binaryfile** (*Path*) – path to binary file (metadata file is assumed to be at same location with ".json" suffix)
- **metafile** (*Path*) – use given metafile rather than inferring metafile name from the binary file name

Returns Migration object representing binary data in the given file.

emod_api.migration.migration.**examine_file**(*filename*)

emod_api.migration.migration.**from_params**(*demographics_file_path=None*, *pop=1000000.0*, *num_nodes=100*, *mig_factor=1.0*, *frac_rural=0.3*, *id_ref='from_params'*, *migration_type=1*)
This function is for creating a migration file that goes with a (multinode) demographics file created from a few parameters, as opposed to one from real-world data. Note that the 'demographics_file_path" input param is not used at this time but in future will be exploited to ensure nodes, etc., match.

emod_api.migration.migration.**from_demog_and_param_gravity_webservice**(*demographics_file_path: str*, *params: str*, *id_ref: str*, *migration_type=1*) → *emod_api.migration.migration.Migration*

Calls a webservice (running on a GPU) to calculate the migration patterns quickly.

Parameters

- **demographics_file_path** – Path to the demographics file.
- **params** – Path to the json file with parameters for gravity calculation and server url.
- **id_ref** – Metadata tag that needs to match corresponding value in demographics file.
- **migration_type** – Migration type.

Returns Migration object

emod_api.migration.migration.**from_demog_and_param_gravity**(*demographics_file_path*, *gravity_params*, *id_ref*, *migration_type=1*)

emod_api.migration.migration.**to_csv**(*filename: pathlib.Path*)

emod_api.migration.migration.**from_csv**(*filename: pathlib.Path*, *id_ref*, *mig_type=None*)

Create migration from csv file. The file should have columns 'source' for the source node, 'destination' for the destination node, and 'rate' for the migration rate.

Parameters **filename** – csv file

Returns Migration object

emod_api.schema package

Submodules

emod_api.schema.dtk_post_process_schema module

emod_api.schema.dtk_post_process_schema.**recurser**(*in_json*)

emod_api.schema.dtk_post_process_schema.**application**(*schema_file*)

emod_api.schema.get_schema module

emod_api.schema.get_schema.**dtk_to_schema**(*path_to_binary*, *path_to_write_schema='schema.json'*)

Runs /path/to/Eradication –get-schema –schema-path=schema.json and then post-processes the schema into something more useful. Error cases handled: - schema.json file already exists in cwd; does not overwrite. Asks users to move and retry. - Specified binary fails to run to completion. - Specified binary fails to produce a schema.json

emod_api.serialization package

Submodules

emod_api.serialization.CensusAndModPop module

emod_api.serialization.CensusAndModPop.**change_ser_pop**(*input_serpop_path*, *mod_fn=None*, *save_file_path=None*)

This function loads a serialization population file, iterates over each person, calls a user-provided callback with each individuals, and saves the population as manipulated by the user.

The mod function can act at will on the population object. There are no checks.

The new file is saved to a name provided by user. Interactive if none provided to function.

Assuming a single node file for now.

emod_api.serialization.SerializedPopulation module

Class to load and manipulate a saved population.

class emod_api.serialization.SerializedPopulation.**SerializedPopulation**(*file: str*)

Bases: object

Opens the passed file and reads in all the nodes.

Parameters **file** – serialized population file

Examples

Create an instance of SerializedPopulation:

```
import emod_api.serialization.SerializedPopulation as SerPop
ser_pop = SerPop.SerializedPopulation('state-00001.dtk')
```

property nodes

All nodes.

Examples

Delete number_of_ind individuals from node 0:

```
node = ser_pop.nodes[0]
del node.individualHumans[0:number_of_ind]
```

Only keep individuals with a certain condition:

```
node.individualHumans = [ind for ind in node.individualHumans if keep_fct(ind)]
```

Change susceptibility of an individual:

```
print(node.individualHumans[0].susceptibility)
new_susceptibility = {"age": 101.01, "mod_acquire": 0}
node.individualHumans[0].susceptibility.update(new_susceptibility)
```

Copy individual[0] from node 0, change properties and add individual as new individual:

```
import copy
individual_properties={"m_age": 1234}
individual = copy.deepcopy(node.individualHumans[0])
individual["suid"] = ser_pop.get_next_individual_suid(0)
individual.update(individual_properties)
ser_pop.nodes[0].individualHumans.append(individual)
```

Infect an individual with an infection copied from another individual:

```
infection = node["individualHumans"][0]["infections"][0]
infection["suid"] = self.get_next_infection_suid()
node["individualHumans"][1]["infections"].append(infection)
node["individualHumans"][1].m_is_infected = True
```

flush()
Save all made changes to the node(s).

write(*output_file: str = 'my_sp_file.dtk'*)
Write the population to a file.

Parameters **output_file** – output file

get_next_infection_suid()
Each infection needs a unique identifier, this function returns one.

get_next_individual_suid(*node_id: int*) → dict
Each individual needs a unique identifier, this function returns one.

Parameters **node_id** – The first parameter.

Returns The return value. True for success, False otherwise.

Examples

To get a unique id for an individual:

```
print(sp.get_next_individual_suid(0))
{'id': 2}
```

emod_api.serialization.SerializedPopulation.**find**(*name: str*, *handle*, *currentlevel='dtk.nodes'*)
Recursively searches for a paramters that matches or is close to name and prints out where to find it in the file.

Parameters

- **name** – the paramter you are looking for e.g. “age”, “gender”.
- **handle** – some iterable data structure, can be a list of nodes, a node, list of individuals, etc currentlevel: just a string to print out where the found item is located e.g. “dtk.nodes” or “dtk.node.individuals”

Examples

What is the exact paramteter name used for the age of an individual?:

```
SerPop.find("age", node)
...
1998   Found in:  dtk.nodes.individualHumans[999].m_age
1999   Found in:  dtk.nodes.individualHumans[999].susceptibility.age
2000   Found in:  dtk.nodes.m_vectorpopulations[0].EggQueues[0].age
2001   Found in:  dtk.nodes.m_vectorpopulations[0].EggQueues[1].age
...
```

emod_api.serialization.SerializedPopulation.**get_parameters**(*handle*, *currentlevel='dtk.nodes'*)
Return a set of all parameters in the serialized population file. Helpful to get an overview about what is in the serialized population file.

Parameters

- **handle** – some iterable data structure, can be a list of nodes, a node, list of individuals, etc
- **currentlevel** – just a string to print out where the found item is located e.g. "dtk.nodes"or "dtk.node.individuals

Examples

Print all parameters in serialized population file:

```
for n in sorted(SerPop.get_parameters(node)):
    print(n)
```

emod_api.serialization.dtkFileSupport module

class emod_api.serialization.dtkFileSupport.**Uncompressed**
Bases: object

classmethod compress(*data*)

classmethod uncompress(*data*)

class emod_api.serialization.dtkFileSupport.**EllZeeFour**
Bases: object

classmethod compress(*data*)

classmethod uncompress(*data*)

class emod_api.serialization.dtkFileSupport.**Snappy**
Bases: object

classmethod compress(*data*)

classmethod uncompress(*data*)

class emod_api.serialization.dtkFileSupport.**SerialObject**(*dictionary={}*)
Bases: dict

class emod_api.serialization.dtkFileSupport.**NullPtr**
Bases: *emod_api.serialization.dtkFileSupport.SerialObject*

emod_api.serialization.dtkFileTools module

Support for three formats of serialized population files: 1. “Original version”: single payload chunk with simulation and all nodes, uncompressed or snappy or LZ4 2. “First chunked version”: multiple payload chunks, one for simulation and one each for nodes 3. “Second chunked version”: multiple payload chunks, simulation and node objects are “root” objects in each chunk 4. “Metadata update”: compressed: true|false + engine: NONE|LZ4|SNAPPY replaced with compression: NONE|LZ4|SNAPPY

emod_api.serialization.dtkFileTools.**uncompress**(*data*, *engine*)

emod_api.serialization.dtkFileTools.**compress**(*data*, *engine*)

class emod_api.serialization.dtkFileTools.**DtkHeader**(*dictionary=None*)
Bases: *emod_api.serialization.dtkFileSupport.SerialObject*

class emod_api.serialization.dtkFileTools.**DtkFile**(*header*)
Bases: object

class Contents(*parent*)
Bases: object

append(*item*)

class Objects(*parent*)
Bases: object

append(*item*)

property header

property compressed

property compression

property byte_count

property chunk_count

property chunk_sizes

property author

property date

property tool

property version

property chunks

property nodes

class emod_api.serialization.dtkFileTools.**DtkFileV1**(*header=None*, *filename=''*, *handle=None*)
Bases: *emod_api.serialization.dtkFileTools.DtkFile*

property simulation

class emod_api.serialization.dtkFileTools.**DtkFileV2**(*header=None*, *filename=''*, *handle=None*)
Bases: *emod_api.serialization.dtkFileTools.DtkFile*

class NodesV2(*parent*)
Bases: object

property simulation

class emod_api.serialization.dtkFileTools.**DtkFileV3**(*header=None*, *filename=''*, *handle=None*)
Bases: *emod_api.serialization.dtkFileTools.DtkFile*

class **NodesV3**(*parent*)
Bases: object

property **simulation**

class emod_api.serialization.dtkFileTools.**DtkFileV4**(*header=None*, *filename=''*, *handle=None*)
Bases: *emod_api.serialization.dtkFileTools.DtkFileV3*

class emod_api.serialization.dtkFileTools.**DtkFileV5**(*header=None*, *filename=''*, *handle=None*)
Bases: *emod_api.serialization.dtkFileTools.DtkFileV4*

emod_api.serialization.dtkFileTools.**read**(*filename*)

emod_api.serialization.dtkFileTools.**write**(*dtk_file*, *filename*)

emod_api.serialization.dtkFileUtility module

emod_api.spatialreports package

Submodules

emod_api.spatialreports.plot_spat_means module

This script assumes local SpatialReport_XXX.bin files which have been downloaded (from COMPS) using pyCOMPS getexpout function or equivalent. Note that this interacts with files on an experiment basis, not simulation basis. It assumes the files are in a subdirectory named after the experiment id, and then in subdirectories of that named after the simulation id.

<exp_id>/

<sim1_id>/ SpatialReport_XXX.bin

<sim2_id>/ SpatialReport_XXX.bin

The idea is that the data is most interesting not on a simulation basis, but for an experiment, especially aggregated on a certain sweep param and value. This plot calculates means and plots those.

Option 1: For each node, plot the mean of the specified channel for all files (values) found in experiment. Option 2: For each node, plot the mean of the specified channel for all files (values) found in experiment _limited_ by specified tag key-value pair. There is little to no assistance here so you need to specify a valid key and value.

emod_api.spatialreports.plot_spat_means.**collect**(*exp_id*, *chan='Prevalence'*, *tag=None*)

emod_api.spatialreports.plot_spat_means.**plot**(*exp_id*, *chan='Prevalence'*, *tag=None*)

emod_api.spatialreports.spatial module

emod-api spatial report module. Exposes SpatialReport and SpatialNode objects.

class emod_api.spatialreports.spatial.**SpatialNode**(*node_id: int*, *data*)
Bases: object

Class representing a single node of a spatial report.

property **id: int**
Node ID

property **data**
Time series data for this node.

class emod_api.spatialreports.spatial.**SpatialReport**(*filename: Optional[str] = None*, *node_ids: Optional[List[int]] = None*, *data: Optional[numpy.array] = None*, *start: int = 0*, *interval: int = 1*)

Bases: object

Class for reading (and, optionally, writing) spatial reports in EMOD/DTK format. "Filtered" reports will have start > 0 and/or reporting interval > 1.

property data: numpy.array
Returns full 2 dimensional NumPy array with report data. Shape is (#values, #nodes).

property node_ids: List[int]
Returns list of node IDs (integers) for nodes in the report.

property nodes: Dict[int, *emod_api.spatialreports.spatial.SpatialNode*]
Returns dictionary of SpatialNodes keyed on node ID.

property node_count: int
Number of nodes in the report.

property time_steps: int
Number of samples in the report.

property start: int
Time step of first sample.

property interval: int
Interval, in time steps, between samples.

write_file(*filename: str*)
Save current nodes and timeseries data to given file.

emod_api.tabularoutput package

emod_api.weather package

Submodules

emod_api.weather.weather module

emod-api Weather module - Weather, Metadata, and WeatherNode objects along with IDREF and CLIMATE_UPDATE constants.

class emod_api.weather.weather.**WeatherNode**(*node_id: int*, *data*)

Bases: object

Represents information for a single node: ID and timeseries data.

property id: int
Node ID

property data
Time series data for this node.

class emod_api.weather.weather.**Metadata**(*node_ids: List[int]*, *datavalue_count: int*, *author: Optional[str] = None*, *created: Optional[datetime.datetime] = None*, *frequency: Optional[str] = None*, *provenance: Optional[str] = None*, *reference: Optional[str] = None*)

Bases: object

Metadata:

- [DateCreated]
- [Author]
- [OriginalDataYears]
- [StartDayOfYear]
- [DataProvenance]
- IdReference
- NodeCount
- DatavalueCount
- UpdateResolution
- NodeOffsets

property author: `str`
Author of this file.

property creation_date: `datetime.datetime`
Creation date of this file.

property datavalue_count: `int`
Number of data values in each timeseries, should be > 0.

property id_reference: `str`
'Schema' for node IDs. Commonly *Legacy*, *Gridded world grump2.5arcmin*, and *Gridded world grump30arcsec*.

Legacy usually indicates a 0 or 1 based scheme with increasing ID numbers.

Gridded world grump2.5arcmin and *Gridded world grump30arcsec* encode latitude and longitude values in the node ID with the following formula:

```
latitude  = (((nodeid - 1) & 0xFFFF) * resolution) -  90
longitude = ((nodeid >> 16)          * resolution) - 180
# nodeid = 90967271 @ 2.5 arcmin resolution
# longitude = -122.1667, latitude = 47.5833
```

property node_count: `int`

property node_ids: `List[int]`

property provenance: `str`

property update_resolution: `str`

property nodes: `Dict[int, int]`
WeatherNodes offsets keyed by node id.

write_file(*filename: str*) → None

classmethod from_file(*filename: str*)
Read weather metadata file. Metadata' and 'NodeOffsets' keys required. DatavalueCount', 'UpdateResolution', and 'IdReference' required in 'Metadata'.

class emod_api.weather.weather.**Weather**(*filename: Optional[str] = None*, *node_ids: Optional[List[int]] = None*, *datavalue_count: Optional[int] = None*, *author: Optional[str] = None*, *created: Optional[datetime.datetime] = None*, *frequency: Optional[str] = None*, *provenance: Optional[str] = None*, *reference: Optional[str] = None*, *data: Optional[numpy.array] = None*)

Bases: object

property data: numpy.array
Raw data as numpy array[node index, time step].

property metadata: *emod_api.weather.weather.Metadata*

property author: str

property creation_date: datetime.datetime

property datavalue_count: int
>= 1

property id_reference: str

property node_count: int
>= 1

property node_ids: List[int]

property provenance: str

property update_resolution: str

property nodes: Dict[int, *emod_api.weather.weather.WeatherNode*]
WeatherNodes indexed by node id.

write_file(*filename: str*) → None
Writes data to filename and metadata to filename.json.

classmethod from_csv(*filename: str*, *var_column: str = 'airtemp'*, *id_column: str = 'node_id'*, *step_column: str = 'step'*, *author: Optional[str] = None*, *provenance: Optional[str] = None*)
Create weather from CSV file with specified variable column, node id column, and time step column.

Note:

- Column order in the CSV file is not significant, but columns names must match what is passed to this function.
- Because a CSV might hold air temperature (may be negative and well outside 0-1 values), relative humidity (must _not_ be negative, must be in the interval [0-1]), or rainfall (must _not_ be negative, likely > 1), this function does not validate incoming data.

3.1.2 Submodules

emod_api.campaign module

You use this simple campaign builder by importing it, adding valid events via "add", and writing it out with "save".

emod_api.campaign.**reset**()

emod_api.campaign.**set_schema**(*schema_path_in*)
Set the (path to) the schema file. And reset all campaign variables. This is essentially a "start_building_campaign" function. :param schema_path_in. The path to a schema.json.:

Returns N/A.

emod_api.campaign.**add**(*event*, *name=None*, *first=False*)
Add a complete campaign event to the campaign builder. The new event is assumed to be a Python dict, and a valid event. The new event is not validated here. Set the first flag to True if this is the first event in a campaign because it functions as an accumulator and in some situations like sweeps it might have been used recently.

emod_api.campaign.**get_trigger_list**()

emod_api.campaign.**save**(*filename='campaign.json'*)
Save 'camapign_dict' as 'filename'.

emod_api.campaign.**get_adhocs**()

emod_api.campaign.**get_schema**()

emod_api.campaign.**get_recv_trigger**(*trigger*, *old=False*)
Get the correct representation of a trigger (also called signal or even event) that is being listened to.

emod_api.campaign.**get_send_trigger**(*trigger*, *old=False*)
Get the correct representation of a trigger (also called signal or even event) that is being broadcast.

emod_api.campaign.**get_event**(*event*, *old=False*)
Basic placeholder functionality for now. This will map new ad-hoc events to GP_EVENTs and manage that 'cache' If event in built-ins, return event, else if in adhoc map, return mapped event, else add to adhoc_map and return mapped event.

emod_api.multidim_plotter module

emod_api.multidim_plotter.**plot_from_sql**(*x_tag*, *y_tag*, *output*, *label*, *exp_id=None*)
Plot colormap/3D figure from data in <experiment_id>/results.db.

Parameters

- **x_tag** – Tag to use as x axis.
- **y_tag** – Tag to use as y axis.
- **output** – String to use as output, needs to correspond to one of the output cols in the db.
- **label** – Figure needs a label.
- **exp_id** – Optional experiment id. If omitted, 'latest_experiment' is used.

emod_api.peek_camp module

emod_api.peek_camp.**decorate_actual_iv**(*iv*, *signal=None*)

emod_api.peek_camp.**decorate_actual_iv_impl**(*iv*, *signal=None*)
This function converts json interventions to their CCDL versions. This relies on a lot of special-casing.

emod_api.peek_camp.**handle_di**(*iv*)

emod_api.peek_camp.**get_ip**(*coord*)

emod_api.peek_camp.**get_ages**(*coord*)

emod_api.peek_camp.**decode**(*camp_path*, *config_path=None*)

emod_api.peek_camp.**params_to_dict**(*start_day*, *reps=None*, *gap=None*, *nodes=None*, *frac=None*, *sex=None*, *minage=None*, *maxage=None*, *ips=None*, *signal=None*, *iv_name=None*, *payload=None*, *delay=None*)
Take all the CCDL params (When? Where? Who? What? Why?) and create a dictionary from them.

emod_api.peek_camp.**encode**(*encoded_path*)
The encode function takes a CCDL files as input and returns a list of campaign events as dictionaries that can be used to create a campaign json from it using emod-api/emodpy functions. This is early code, use at your own risk, or contribute to its improvement. :)

emod_api.schema_to_class module

emod_api.schema_to_class.**disable_warnings**()
Turn off warnings to console. These can get very verbose.

class emod_api.schema_to_class.**ReadOnlyDict**
Bases: collections.OrderedDict

set_schema(*schema*)
Add schema node.

to_file(*config_name='config.json'*)
Write 'clean' config file out to disk as json. Param: config_name (defaults to 'config.json')

finalize()
Remove all params that are disabled by depends-on param being off and schema node.

emod_api.schema_to_class.**get_default_for_complex_type**(*schema*, *idmtype*)
This function used to be more involved and dumb but now it's a passthrough to get_class_with_defaults. If this approach proves robust, it can probably be deprecated. Depends a bit on completeness of schema.

emod_api.schema_to_class.**get_class_with_defaults**(*classname*, *schema_path=None*)
Returns the default config for a datatype in the schema.

CHAPTER

FOUR

GLOSSARY

The following terms describe both the features and functionality of the emod-api software, as well as information relevant to using emod-api.

asset collection The set of specific input files (such as input parameters, weather or migration data, or other configuration settings) required for running a simulation.

assets See asset collection.

builder TBD

experiment A collection of multiple simulations, typically sent to an HPC.

high-performance computing (HPC) The use of parallel processing for running advanced applications efficiently, reliably, and quickly.

task TBD

template TBD

CHAPTER

FIVE

PLOTTERS

emod-api has various built-in plotting utilities. We expect you have your own favorite tools and scripts but these should help you at least get started and also discover what output files/reports exist and what they contain.

CHAPTER

SIX

PLOT MEAN & SPREAD OF AGGREGATE OUTPUT (INSETCHART.JSON) FOR AN EXPERIMENT

This script works on a set of InsetChart.json files, which are sometimes known as the Default Report.

This script expects the InsetChart.json files for an experiment to be downloaded and present locally in the following structure:

```
├── experiment_id
│   ├── sim_id_1
│   │   └── InsetChart.json
│   ├── sim_id_2
│   │   └── InsetChart.json
│   ├── sim_id_3
│   │   └── InsetChart.json
│   ├── sim_id_4
│   │   └── InsetChart.json
etc.
```

It also expects the <experiment_id>/results.db file to exist. This is created by calling :py:`emodpy.emod_task.EMOD_Task.cache_experiment_metadata_in_sql()`.

You can plot one channel at a time. You can specify the experiment id, but if you don't it will try to find it from a local file called COMPS_ID.

If you don't specify a (COMPS) tag, it plots the mean and spread (1 std-dev) of all the sims. If you specify a tag as '<key>=<value>', it will plot the mean and spread of all the sims with that tag match. Replace <key> with an actual key of course, and same for value. If you specify the tag as '<key>=SWEEP', it will look for all the values of that key and plot the mean and spread for each of them on the same plot.

Code usage

emod_api.channelreports.plot_icj_means()

E.g.,

```
import emod_api.channelreports.plot_icj_means as plotter
data = plotter.collect( "df26ed6c-a33e-ed1-a9fc-b88303911bc1", tag="iv_cost=SWEEP" )
plotter.display( data  )
```

Command-line usage

```
python -m emod_api.channelreports.plot_icj_means [-h] [-c CHANNEL] [-e EXPERIMENT_ID] [-t
TAG]
```

Mean 'InsetChart' Report Plotting

optional arguments:

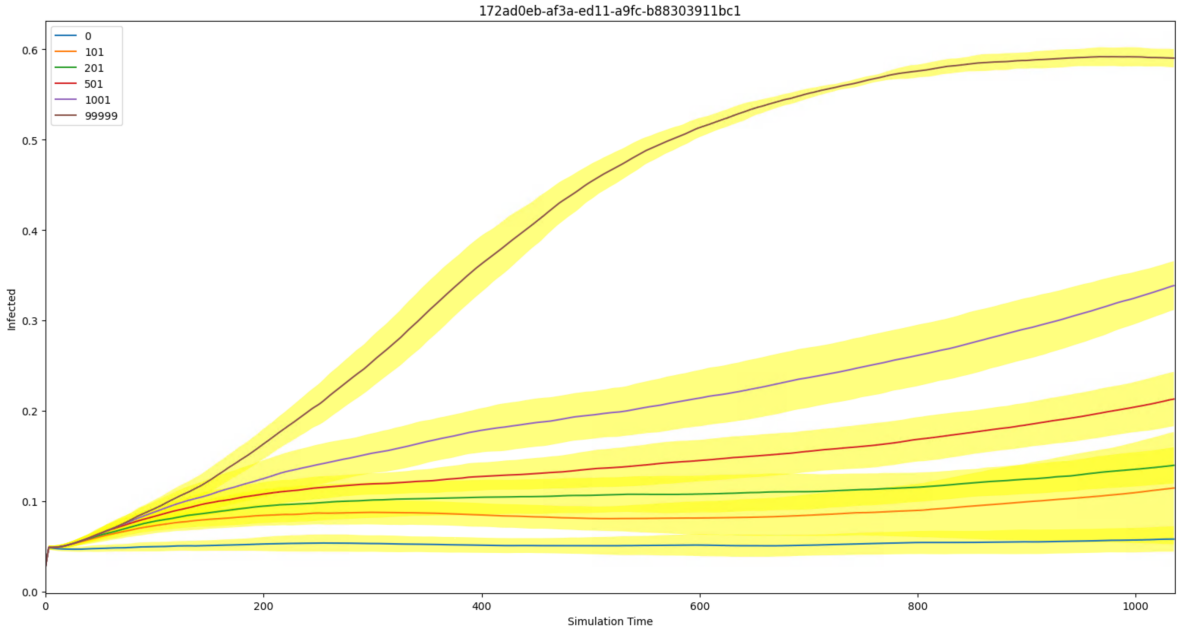
-h, --help show this help message and exit

-c CHANNEL, --channel CHANNEL channel(s) to display [Infected]

-e EXPERIMENT_ID, --experiment_id EXPERIMENT_ID experiment id to plot, data assumed to be local

-t TAG, --tag TAG key=value tag constraint

Sample Output



CHAPTER

SEVEN

PLOT MEAN SPATIAL REPORTS FOR AN EXPERIMENT

This script reads and plots downloaded Spatial Report files from an experiment. It assumes the files are locally present and structured similarly to plot_icj_means.

Code usage

emod_api.spatialreports.plot_spat_means()

E.g.,

```
import emod_api.spatialreports.plot_spat_means as plotter
plotter.plot( "eedf7b5a-3b17-ed11-a9fb-b88303911bc1" )
```

Command-line usage

```
python -m emod_api.spatialreports.plot_spat_means [-h] [-c CHANNEL] [-e EXPERIMENT_ID]
[-t TAG]
```

Spatial Report Plotting

optional arguments:

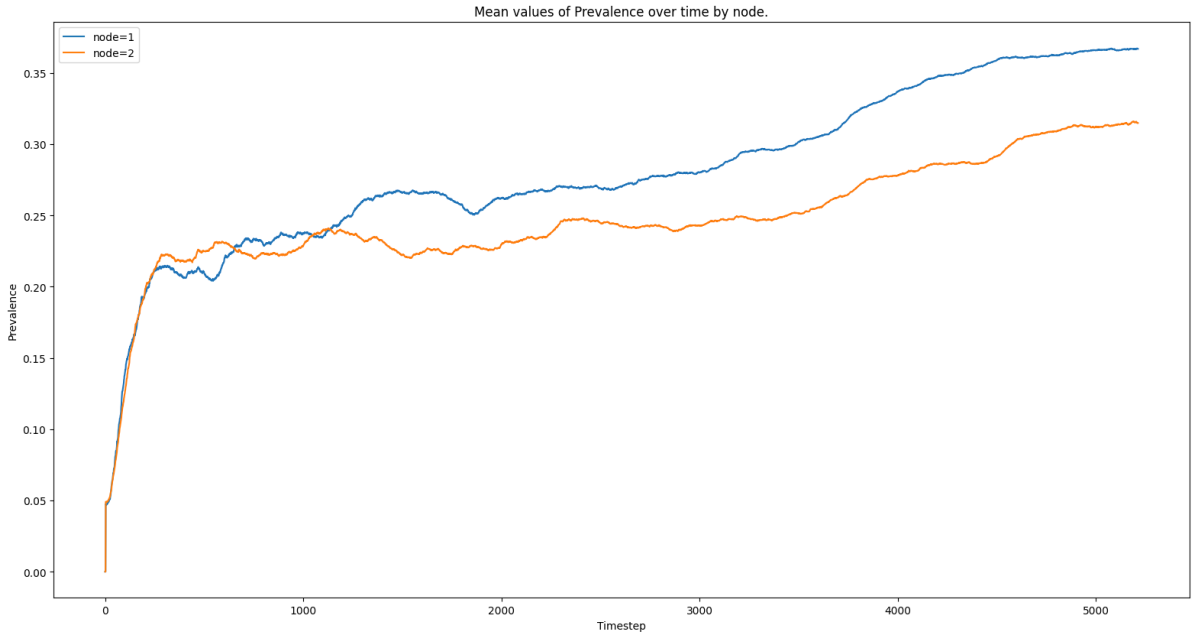
-h, --help show this help message and exit

-c CHANNEL, --channel CHANNEL channel(s) to display [Prevalence]

-e EXPERIMENT_ID, --experiment_id EXPERIMENT_ID experiment id to plot, data assumed to be local

-t TAG, --tag TAG tag constraint

Sample Output


Mean values of Prevalence over time by node.
node=1
node=2
Prevalence
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0
1000
2000
3000
4000
5000
Timestep

CHAPTER

EIGHT

PLOT PROPERTY REPORT FOR A SIMULATION

This script accepts a single PropertyReport.json file as input. Note that this is the only script in this group that accepts a single simulation output file as input (vs. a set of files from an experiment). Unlike InsetChart.json files which have a single aggregated time series per channel, Property Report files are massively disaggregated by design and so are much easier to use with some tooling like this script.

Command-line usage

```
python -m emod_api.channelreports.pplot_prop_report.py [-h] [-c channelName] [-p PRIMARY]
[-n] [-b BY] [-o] [-s] [-m] [-v] [--no-legend] [-l] [filename]
```

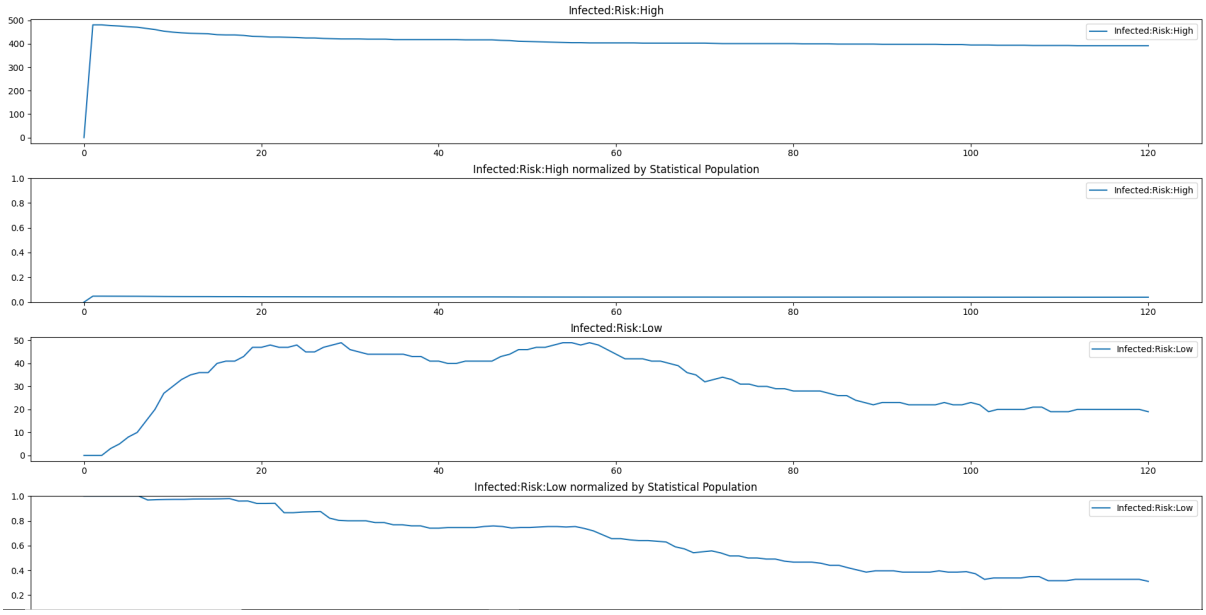
Property Report Plotting

positional arguments: filename property report filename [PropertyReport.json]

optional arguments:

-h, --help	show this help message and exit
-c channelName, --channel channelName	channel(s) to display [Infected]
-p PRIMARY, --primary PRIMARY	Primary IP under which to roll up other IP keys and values
-n, --normalize	plot channel(s) normalized by statistical population
-b BY, --by BY	Channel for normalization [‘Statistical Population’]
-o, --overlay	overlay pools of the same channel
-s, --save	save figure to disk
-m, --matrix	plot matrix for all properties
-v, --verbose	be chatty
--no-legend	hide legend
-l, --list	List channels and IP keys found in the report. No plotting is performed with this option.

Sample Output


Infected:Risk:High
Infected:Risk:High
Infected:Risk:High normalized by Statistical Population
Infected:Risk:High
Infected:Risk:Low
Infected:Risk:Low
Infected:Risk:Low normalized by Statistical Population
Infected:Risk:Low

CHAPTER

NINE

VISUALIZE MULTIDIMENSIONAL SWEEP OUTPUTS

This script reads and plots colormaps of custom output data from an 2-dimensional sweep. It assumes the files are local similarly to plot_icj_means.

Code usage

emod_api.multidim_plotter()

Example:

```
output_for_analysis=["final_prev"]
from emodpy.emod_task import EMODTask as task
task.get_file_from_comps( experiment_id, output_for_analysis )
task.cache_experiment_metadata_in_sql( experiment_id, optional_data_files=output_for_
↪analysis )

import matplotlib.pyplot as plt
import emod_api.multidim_plotter as twoplotter

for output in output_for_analysis:
    twoplotter.plot_from_sql( "Base_Infectivity_Constant", "Rural_Infectivity",␣
↪output=output, label=output )
```

Example Explained:

- final_prev is the name of an output file produced by the dtk_post_process.py script.
- get_file_from_comps is used to get all the copies of 'final_prev' for the entire experiment from COMPS downloaded locally.
- cache_experiment_metadata_in_sql retrieves the tag info from COMPS for the experiment and creates a local sqlite db (called 'results.db', in the latest experiment directory). It will include a column with the value in 'final_prev' for each simulation.
- The function 'plot_from_sql' in multidim_plotter then displays a 3D plot (displayed as a 2D colourmap by default) for the two tag axes specified. The color represents the corresponding value of 'final_prev' in this example.

Command-line usage `python -m emod_api.multidim_plotter [-h] [-x XTAG] [-y YTAG] [-o OUTPUT] [-t TITLE] [-e EXPERIMENT_ID]`

Spatial Report Plotting

optional arguments:

-h, --help show this help message and exit

-x XTAG, --xtag XTAG X tag (must be in db)

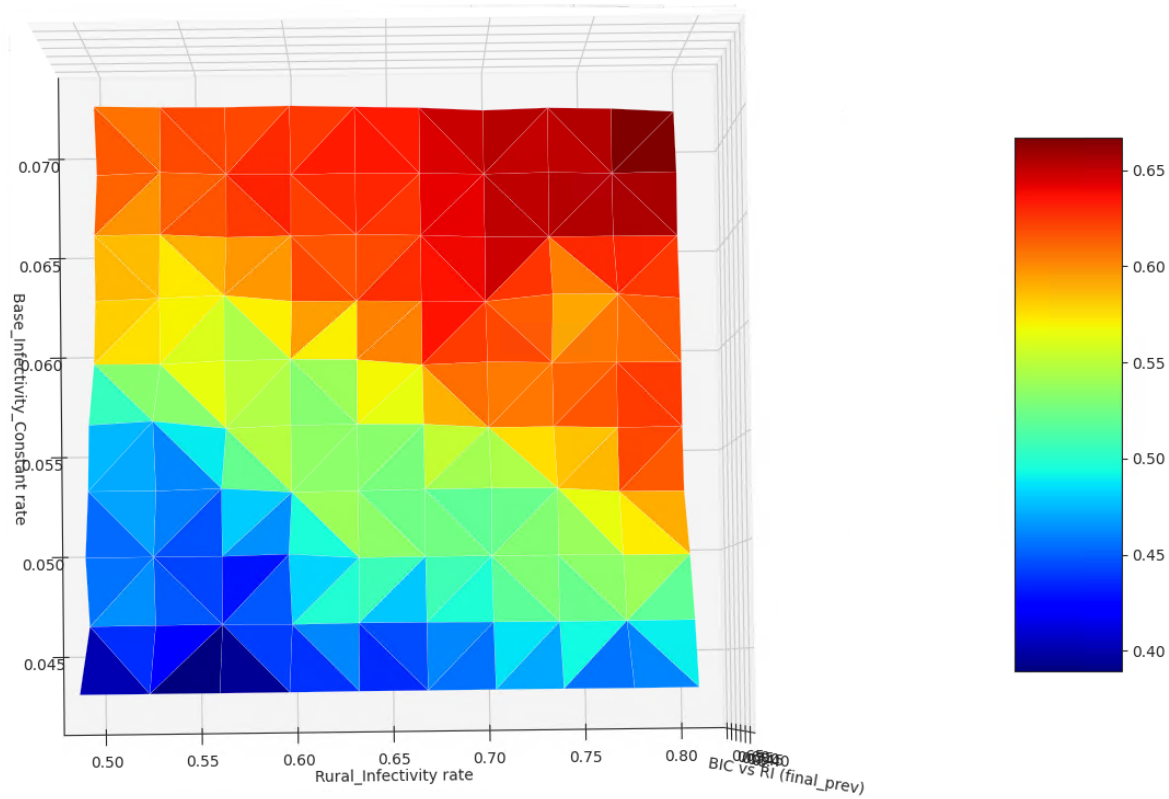
-y YTAG, --ytag YTAG Y tag (must be in db

-o OUTPUT, --output OUTPUT Single value output file

-t TITLE, --title TITLE Graph title

-e EXPERIMENT_ID, --experiment_id EXPERIMENT_ID experiment id to plot, uses latest_experiment folder if omitted (not used yet)

Sample Output



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