

# Simulation Spec File

Erik Brinkman  
erik.brinkman@umich.edu

Elaine Wah  
ewah@umich.edu

Updated: January 26, 2015

## 1 Introduction

The simulation spec file contains the entire configuration of a simulation. It is in JSON format and divided into two main sections: “assignment,” and “configuration.”

The parameters in the specification file are those that can be adjusted in simulations. Below is the example `simulation_spec.json` file found in the `docs` folder:

```
{
  "assignment": {
  },
  "configuration": {
    "randomSeed": "271828",
    "numSims": "1",
    "simLength": "60000",
    "tickSize": "1",
    "nbboLatency": "100",
    "marketLatency": "0",
    "reentryRate": "0.0005",
    "fundamentalMean": "100000",
    "fundamentalKappa": "0.05",
    "fundamentalShockVar": "1E8",
    "privateValueVar": "1E8",
    "CDA": "num_2",
    "LA": "num_1",
    "ZIR": "num_61_maxPosition_10"
  }
}
```

## 2 Assignment

The “assignment” section is primarily for use with EGTA. It contains a nested listing of player roles with strategies assigned to players. There are currently three agent roles:

**BACKGROUND:** Background traders, who possess a private valuation for the security.

**MARKETMAKER:** Marker makers, who do not have private values.

**HFT:** High-frequency traders.

Each role used in the simulation is followed by a list of agent-strategy pairs, which take the format `<agentType>:<key>_<value1>_<key>_<value2>...`. Each agent present in the simulation is specified on its own line. For example, the section below specifies two background traders, one with range `[0,5000]` and one with range `[0,1000]`, and a single market maker employing the BASICMM strategy with 100 rungs:

```
{
  "assignment": {
    "BACKGROUND": [
      "ZIR:rMin_0_rMax_1000",
      "ZIR:rMin_0_rMax_5000"
    ],
    "MARKETMAKER": [
      "BASICMM:k_100"
    ]
  }
  ...
}
```

### 3 Configuration

The “configuration” section specifies the parameters for the market environment as well as the agent population present. An explanation of select parameters follows (also see Table 1):

**presets:** This is a way to get easy access to “standard” market configurations. Currently there are four options:

**CENTRALCDA:** A single CDA Market.

**CENTRALCALL:** A single CALL Market that clears at the `nbboLatency`.

**TWOMARKET:** Two CDA markets and no latency arbitrageur.

**TWOMARKETLA:** Two CDA markets and a single latency arbitrageur.

**MAXEFF:** One call market, 66 background agents with max position 10.

**Markets:** The next set of options allow manually specifying market configurations if a preset is not used. Currently, there are two types of markets: **CDA** and **CALL**. The configuration string takes the format `<key1>_<value1>_<key>_<value2>...`, and can contain several comma-separated configurations. The following entry would create three CALL markets. Two of these will clear every 100 ms, and one will clear every second:

```
"CALL" : "num_2_clearInterval_100,num_1_clearInterval_1000"
```

Refer to Table 2 for details on market-specific settings.

**Agents:** The next set of options allow manually specifying agent configurations (NOTE: LA configurations can only be set if a **preset** is not being used). Each agent takes a configuration

Name	Default	Description
numSims	1	Number of simulations to pre-aggregate; e.g., setting this parameter to 5 will generate observation files containing mean values from 5 simulation runs.
randomSeed	system time	Seed for the pseudorandom number generator. Random number generation is linked to the observation number, therefore a sequence of observations 0 to N will have different random numbers even when run with the same simulation spec file (and the same seed). Entering the same random seed for different models allows comparison with simulations run with common random numbers.
presets	<i>(undefined)</i>	CENTRALCDA, TWOMARKET, CENTRALCALL, TWOMARKETLA, or MAXEFF
simLength	60000	Length of simulation in time ticks (usually interpreted as milliseconds).
nbboLatency	0	Latency to update both the NBBO quote through the SIP in time steps (usually interpreted in milliseconds).
marketLatency	0	Default quote & transaction update latency for all markets.
laLatency	0	Latency of the latency arbitrageur
reentryRate	0.005	Rate of entry / reentry for all agents. MarketMakers also enter time 0. HFT agents never enter via normal reentry. Can also be set for an agent individually, if part of its strategy.
backgroundReentryRate	reentryRate	Used by background agent if in agent constructor
marketmakerReentryRate	reentryRate	Used by market maker if in agent constructor
tickSize	1	Prices are integers, so the smallest tick size is 1.
maxPosition	10	Max position (long or short) for background agents.
privateValueVar	1E6	Variance of normally distributed i.i.d. elements of private value array; only applicable to background agents.
fundamentalMean	100000	Mean for the public global fundamental value.
fundamentalKappa	0.05	Mean-reversion parameter for the fundamental; higher kappa indicates greater degree of mean-reversion.
fundamentalShockVar	1E6	Variance of shock to global fundamental (which is normally distributed around mean 0).
discountFactors	[0]	A list of the discount factors agents should use when calculating utility. The first discount factor is also what is used to calculate payoff when an agent is a player.

Table 1: List of environment configuration parameters.

Market parameter	Default	Description
num	0	Number of markets with a specific market configuration
clearInterval	1000	Length of clearing interval of <b>CALL</b> market
pricingPolicy	0.5	<b>CALL</b> market pricing policy

Table 2: List of market configuration parameters.

string identical in style to a market, except agents will take different parameters. See Table 3 for details.

The current agents available are **BASICMM**, **MAMM**, **WMAMM**, **ADAPTIVEMM**, **FUNDAMENTALMM**, **ZI**, **ZIR**, **ZIRP** **ZIP**, **AA**, and **LA**.

Agent parameter	Default	Description
num	0	Number of a specific agent configuration
withdraw	true	If true, withdraws orders upon each reentry
window	5000	Length of window to process, for WindowAgents
LA parameter	Default	Description
alpha	0.001	Profit threshold of LA
laLatency	0	Latency of LA
ZI parameter	Default	Description
Rmin	0	Bid range minimum
Rmax	5000	Bid range maximum
thresh	0.001	Profit threshold of ZIRP
MM parameter	Default	Description
K	100	Number of rungs on each side of the ladder
size	100	Rung size
trunc	true	If true, will truncate the ladder to avoid crossing current quote
tickOutside	false	If true, given ladder center prices that match the <i>BID</i> and <i>ASK</i> , will modify to be <i>outside</i> the quote by 1 tick (that is, lower than the <i>BID</i> , higher than the <i>ASK</i> )
tickImprove	true	If true, will modify ladder central if matches the current price quote (on either side)
initLadderMean	meanValue	Ladder center initialization
initLadderRange	1000	Ladder spread initialization
spread	-1	Constant spread for FUNDMM ladder. If this is nonpositive, MM uses the spread of the most recent price quote for the spread of its ladder.
N	5	Number of historical prices (quotes) to use
W	0	Weight factor $\in [0, 1)$ for WMAMM; if 0, linearly weighted, otherwise exponentially weighted.
median	false	If true, AdaptiveMM will use median spread-based strategy
fastLearn	true	If true, AdaptiveMM will use modification to learn more quickly (for updating G)
lastPrice	true	If true, AdaptiveMM will use the last price, rather than the current price, to evaluate each spread-based strategy's performance
strats	500, 1000, 2500, 5000	Initial spreads for strategies used by AdaptiveMM. Delimited in strategy string by hyphen “-”

Table 3: Incomplete list of agent configuration parameters. AAAgent and ZIPAgent parameters will eventually be converted into groups, and thus are not included here. Note that all boolean parameters can be specified by “T/t” and “F/f” in addition to “true” and “false.”