Practical No. 3

Question 3:

Design and Develop Agent Based Model:

- Simulating agent impatience
- Comparing model runs with different parameter valued

Agent-Based Model of Market Dynamics with Agent Impatience

Introduction:

Agent-based modelling (ABM) is a powerful tool for simulating complex systems such as financial markets. In this study, we develop an ABM to simulate market dynamics, incorporating agent impatience as a factor. We compare model runs with different parameter values to analyse the impact of impatience on market behaviour and outcomes. Understanding market dynamics is crucial for businesses, policymakers, and researchers. Agent-based modelling provides a bottom-up approach to modelling market behaviour, where individual agents interact within an environment, leading to emergent market phenomena. In this study, we focus on incorporating agent impatience into the model to analyse its effects on market dynamics.

Aim:

The aim of this study is to develop an agent-based model to simulate market dynamics, considering agent impatience, and compare model runs with different parameter values to analyse its impact on market behaviour and outcomes.

Procedure:

1. Agent Population:

Agent Attributes: Each trader agent is characterized by attributes such as cash, holdings, trading strategy, risk tolerance, and impatience level.

Initialization: Traders are randomly distributed in the market with initial cash, holdings, and impatience levels.

Interaction: Traders interact with each other and the market based on predefined rules governing trading behaviour, such as buying, selling, setting limit orders, and changing trading strategies. Impatient agents have a higher tendency to make rapid trading decisions.

2. Agent Behaviour:

Impatient Behaviour:

Define impatience level for each agent, representing their tolerance for waiting before making a trading decision.

Implement impatience as a factor influencing the timing of trading decisions:

Impatient agents are more likely to make rapid trading decisions without waiting for optimal conditions.

3. Model Output Visualization:

Chart: Line charts are used to visualize various market metrics over time:

Price trends: Plot market prices over time.

Trading volume: Plot trading volume over time.

Market liquidity: Plot bid-ask spreads or market depth over time.

Impact of agent impatience on market behaviour and outcomes.

4. Simulation Setup and Execution:

Set simulation parameters such as impatience levels, trading strategies, market conditions, and initial market state.

Run the simulation with different parameter values to compare model runs and analyse the impact of agent impatience on market dynamics and outcomes.

5. Analysis and Interpretation:

Analyse the simulation results to gain insights into market dynamics:

Evaluate the impact of agent impatience on market behaviour, such as price volatility, trading volume, and market liquidity.

Compare model runs with different impatience levels to assess the sensitivity of the model to parameter values.

6. Model Validation and Sensitivity Analysis:

Validate the model by comparing simulation results with real-world market data.

Perform sensitivity analysis to evaluate the robustness of the model to changes in impatience levels and other parameter values.

Steps:

1. Setting up the Agent Population:

- Open AnyLogic and create a new project.
- Create an Agent Population representing traders:
- Define agent attributes such as cash, holdings, trading strategy, risk tolerance, and impatience level.
- Initialize the agent population by randomly distributing traders in the market with initial cash, holdings, and impatience levels.
- Define interactions between agents and the market based on predefined rules governing trading behaviour, such as buying, selling, setting limit orders, and changing trading strategies.

2. Agent Behaviour:

- Impatient Behaviour:
- Define impatience level for each agent, representing their tolerance for waiting before making a trading decision.
- Implement impatience as a factor influencing the timing of trading decisions:
- Impatient agents are more likely to make rapid trading decisions without waiting for optimal conditions.
- Implement algorithms to model impatience-driven trading behaviour.

3. Model Output Visualization:

- Create line charts and graphs to visualize various market metrics over time:
- Price trends: Plot market prices over time.
- Trading volume: Plot trading volume over time.
- Market liquidity: Plot bid-ask spreads or market depth over time.
- Impact of agent impatience on market behaviour and outcomes.

4. Simulation Setup and Execution:

- Set simulation parameters such as impatience levels, trading strategies, market conditions, and initial market state.
- Configure simulation experiments to explore different scenarios and parameter settings.
- Run the simulation to observe the impact of agent impatience on market dynamics and outcomes.

5. Analysis and Interpretation:

- Analyse the simulation results to gain insights into market dynamics:
- Evaluate the impact of agent impatience on market behaviour, such as price volatility, trading volume, and market liquidity.
- Compare model runs with different impatience levels to assess the sensitivity of the model to parameter values.

6. Model Validation and Sensitivity Analysis:

- Validate the model by comparing simulation results with real-world market data.
- Perform sensitivity analysis to evaluate the robustness of the model to changes in impatience levels and other parameter values.
- By following these steps and using AnyLogic software, you can develop an agent-based model of market dynamics with agent impatience and gain valuable insights into market behaviour and outcomes.
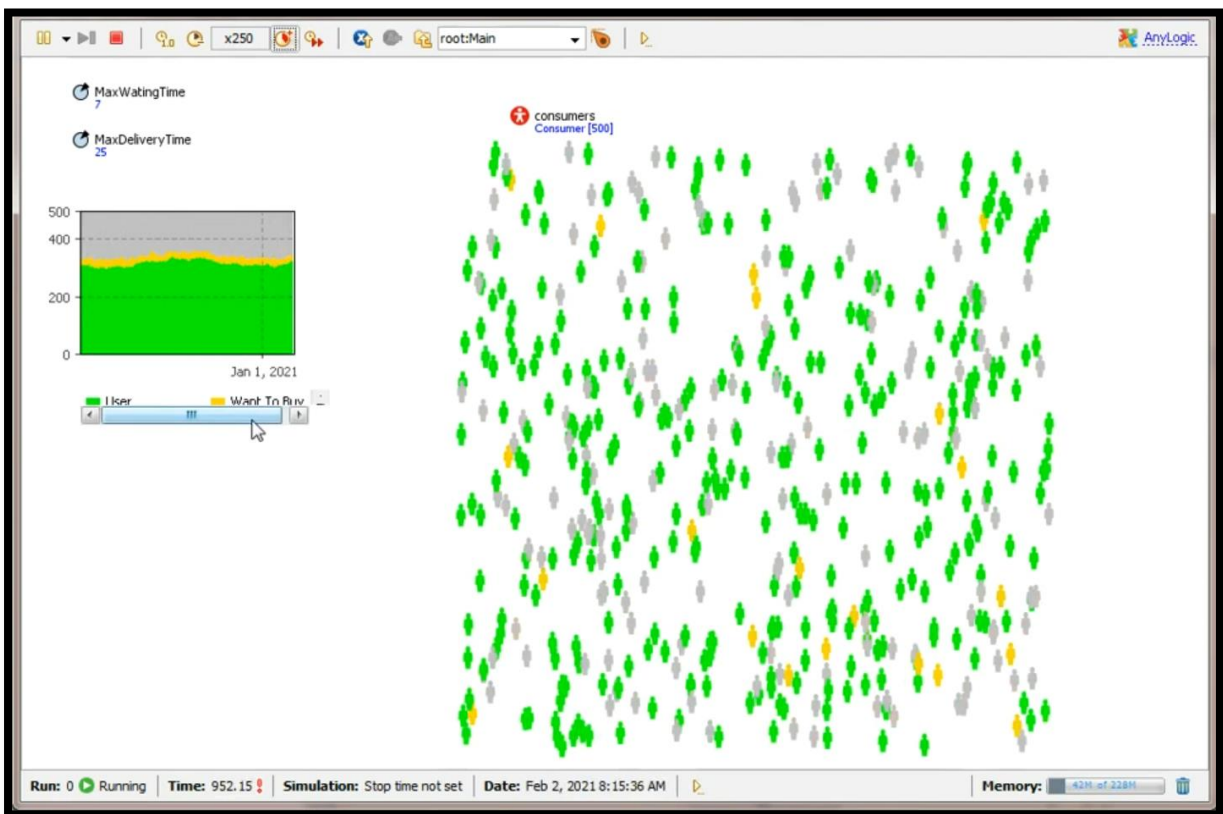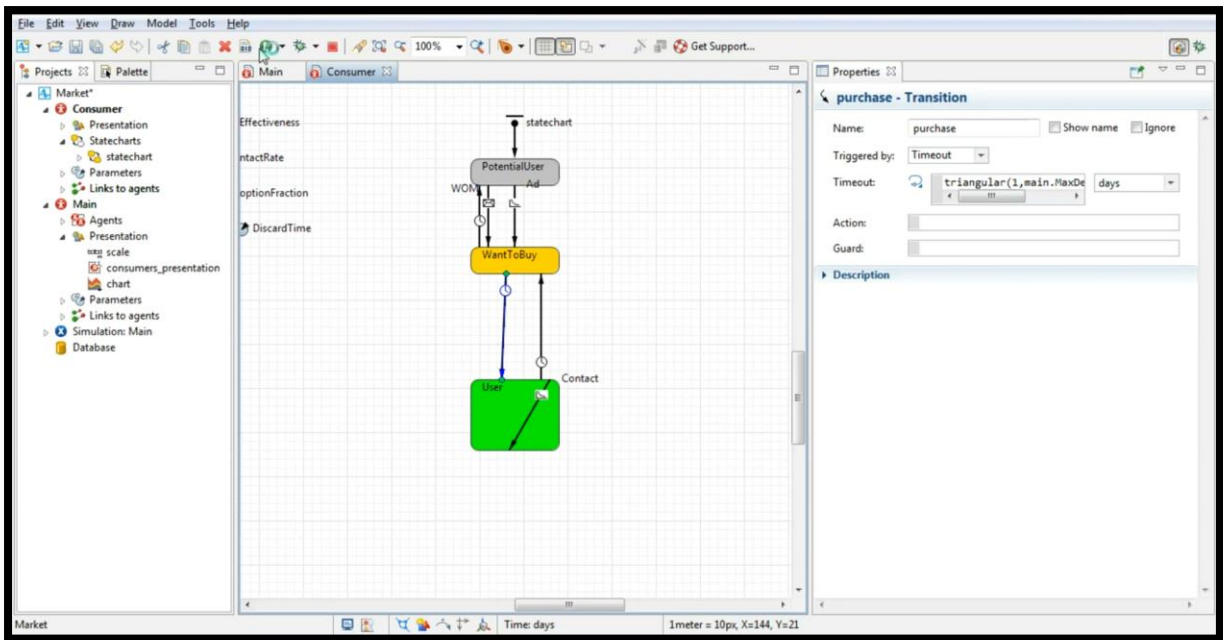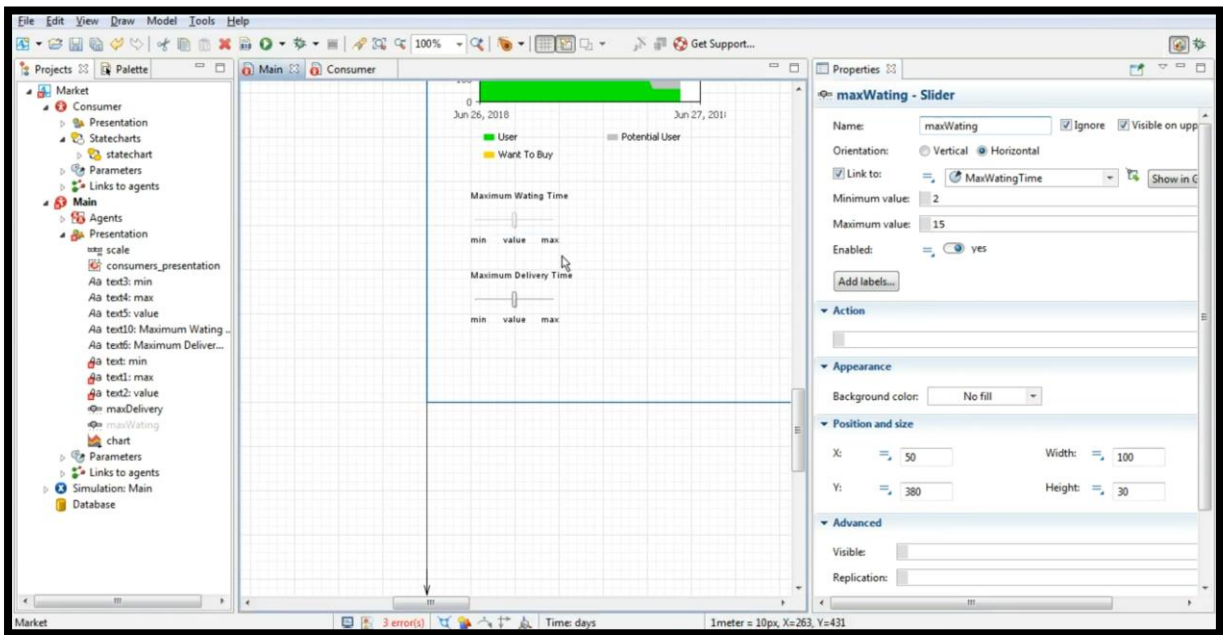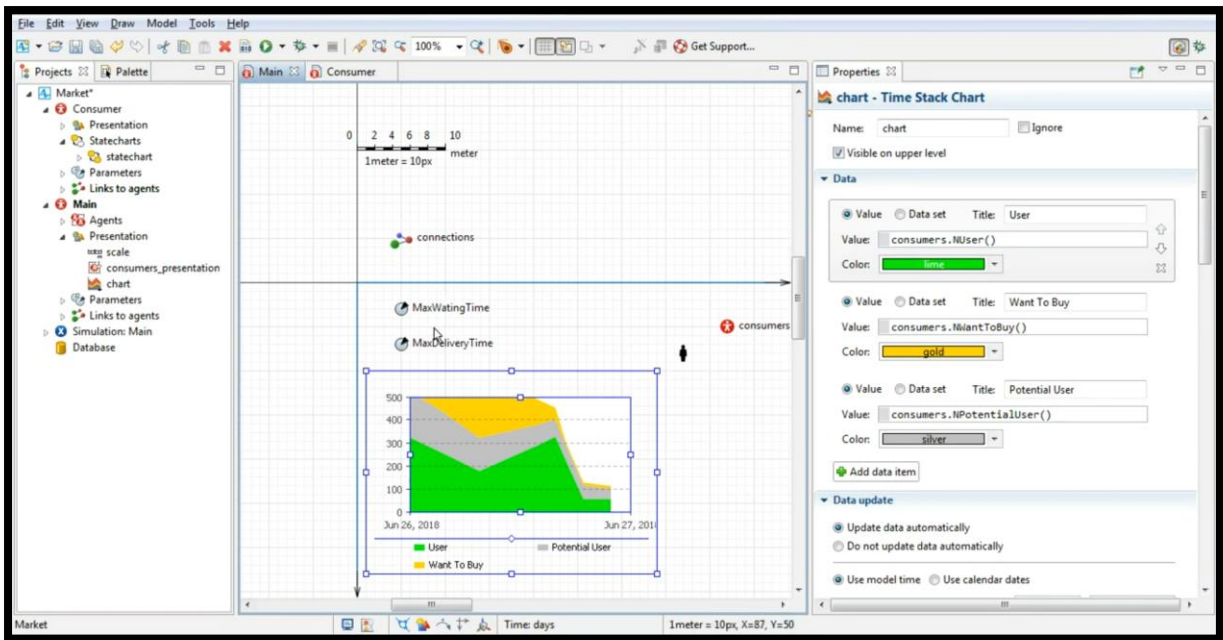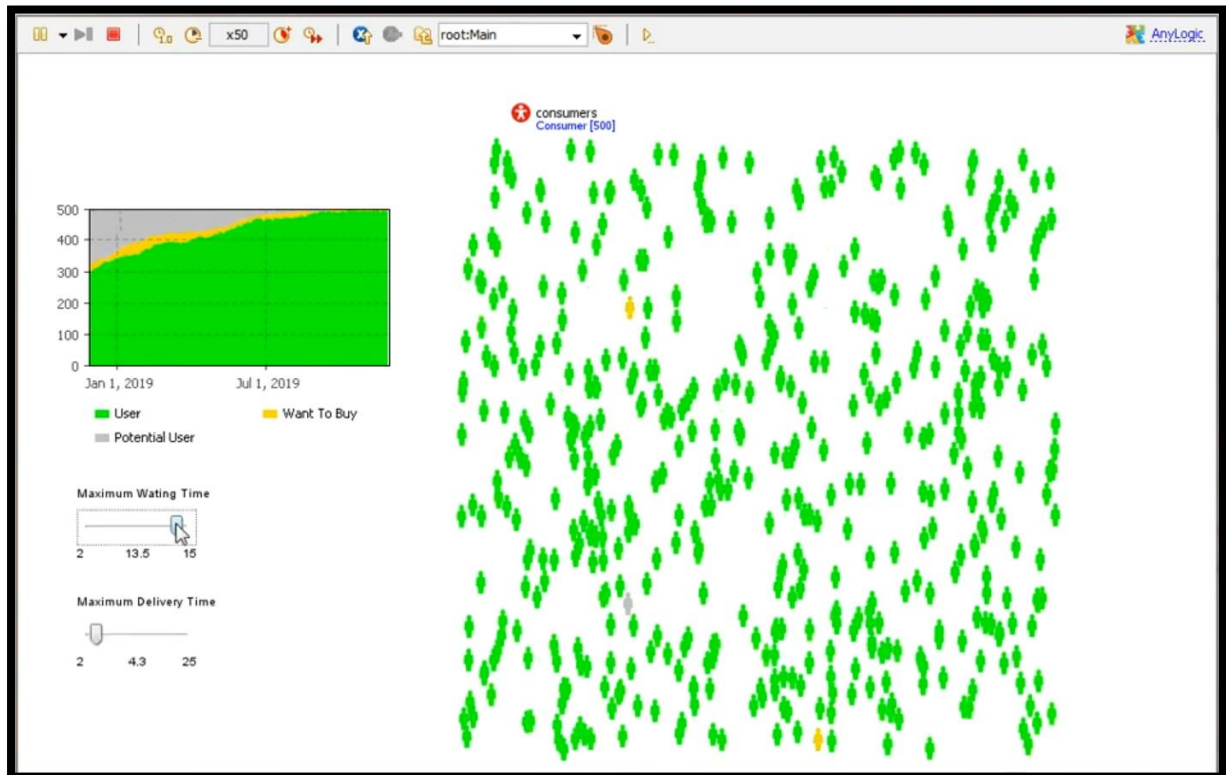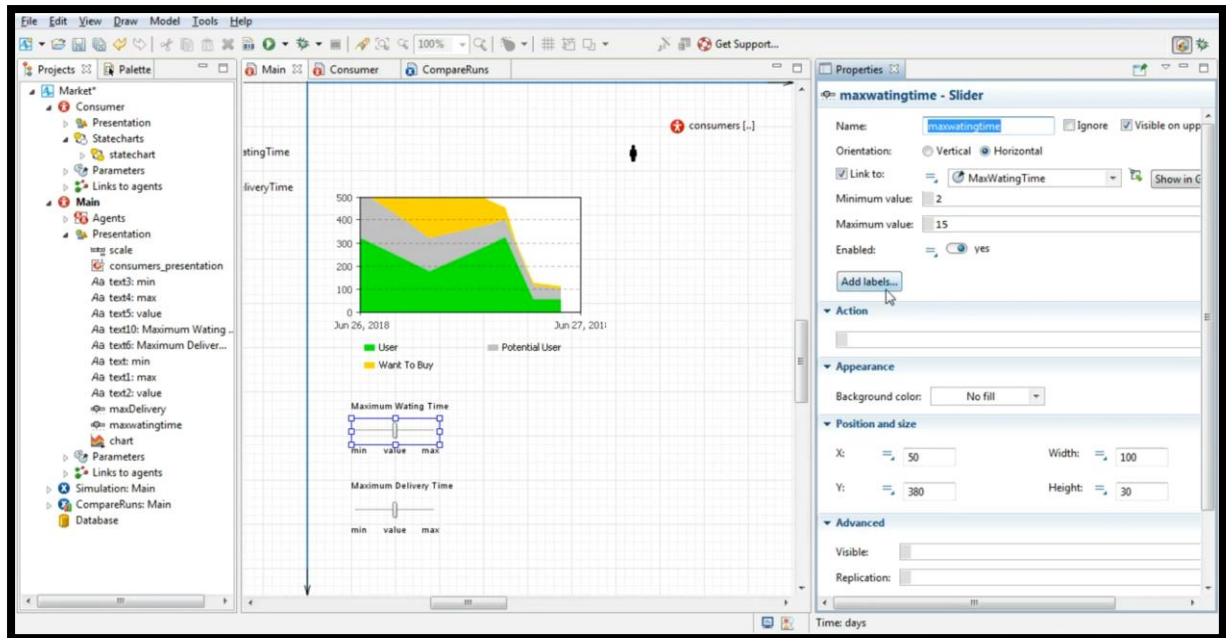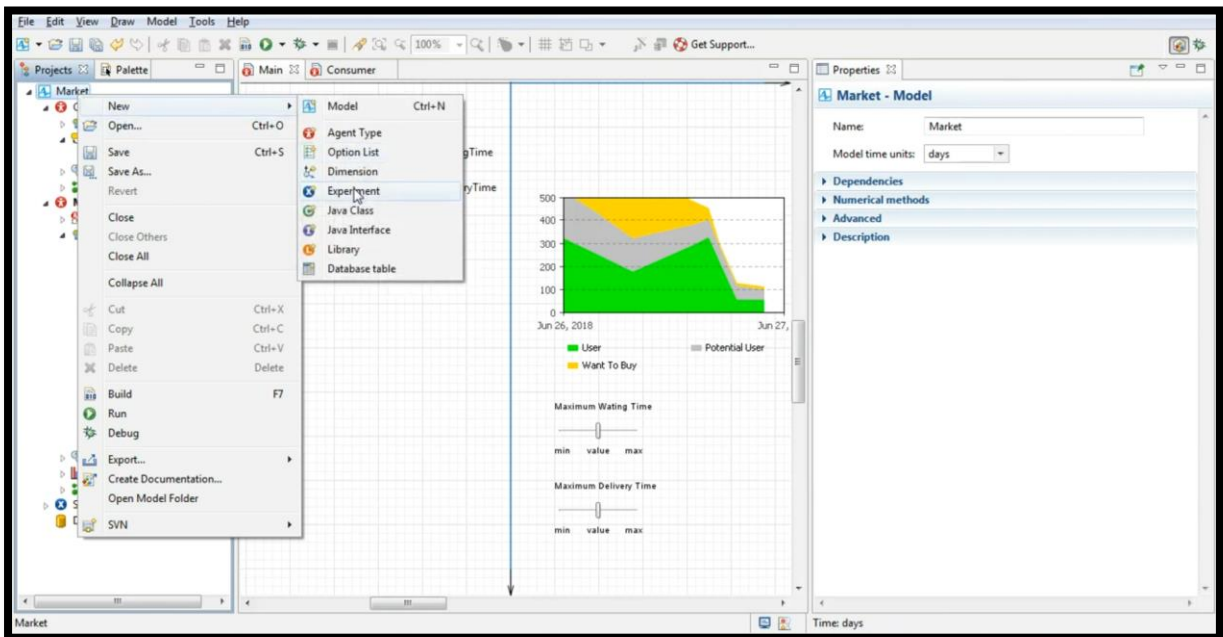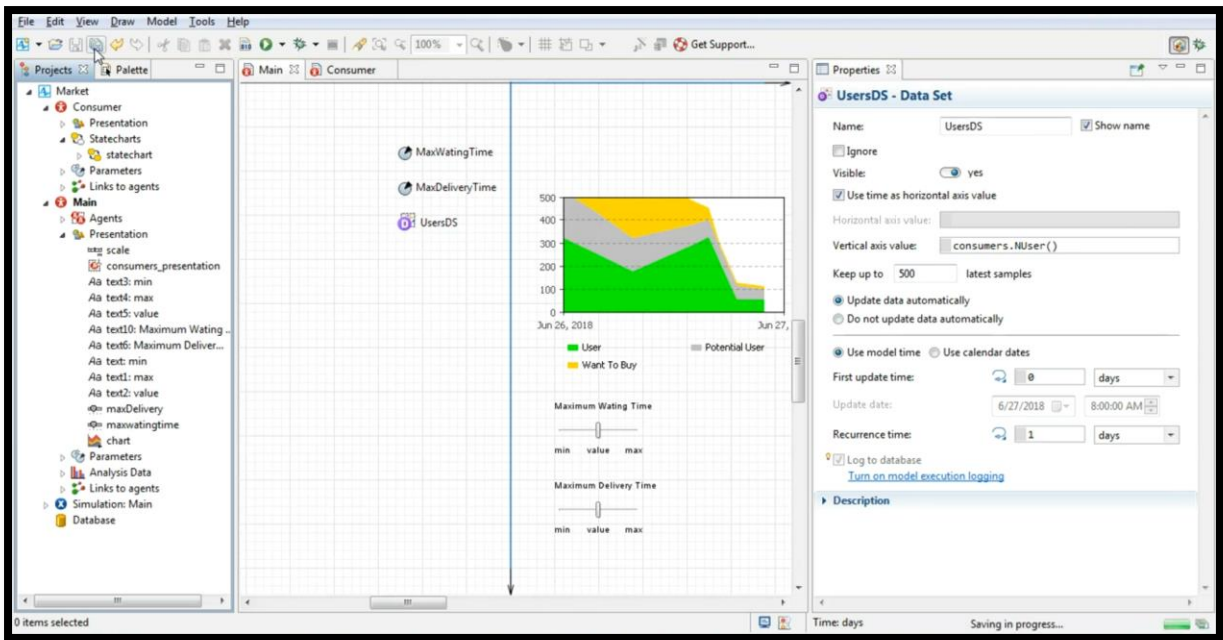
New Experiment

Experiment

Select an experiment type, specify a name and choose a top-level agent.

Name: CompareRuns

Top-level agent: Main

Experiment Type:

- Simulation
- Optimization
- Parameter Variation
- Compare Runs
- Monte Carlo
- Sensitivity Analysis
- Calibration
- Custom

Enables you to interactively input different parameter values and run the model multiple times.
Visually compares outputs of simulation runs in both scalar and dataset forms.

☑ Copy model time settings from: Simulation

< Back   Next >   Finish   Cancel

New Experiment - Compare Runs

Charts

Define the charts to compare the simulation output.

Type	Chart Title	Expression
dataset	Users	root.UsersDS

Available types of charts: plots for datasets and bar charts for scalar values. Use "root" in Expression to refer to the top level agent, e.g. "root.myDataset".
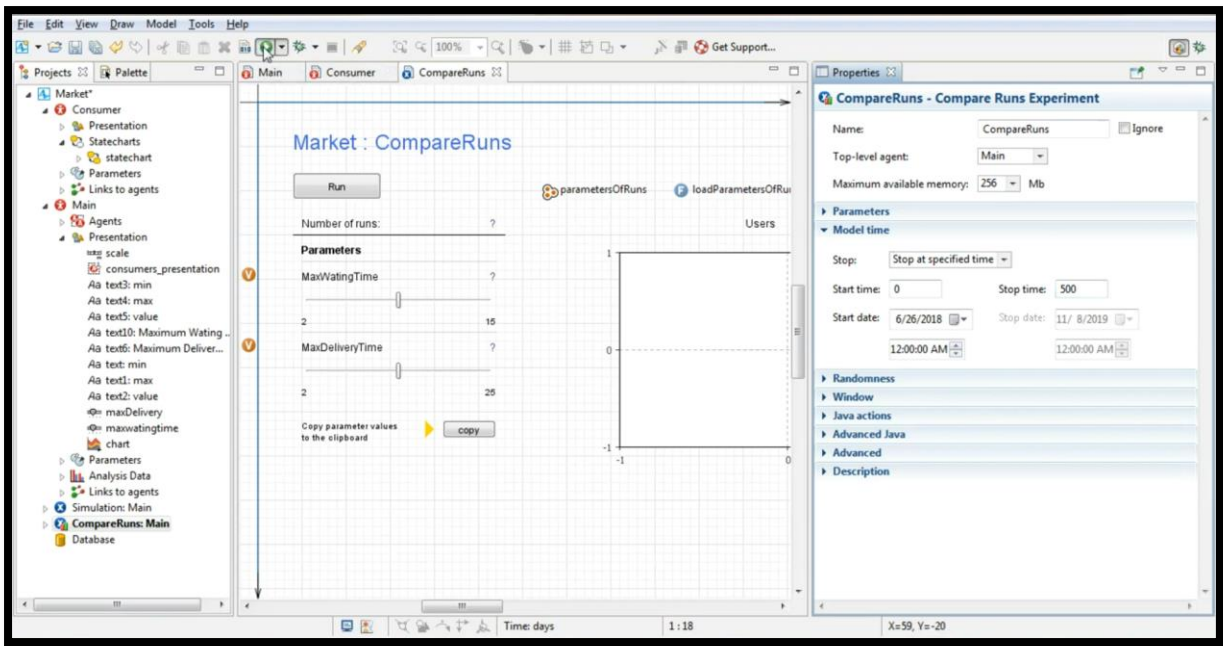
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Conclusion:

The agent-based model developed in this study successfully simulates market dynamics, considering agent impatience as a factor. By capturing the behaviour of impatient agents and their interactions, the model provides insights into the impact of impatience on market behaviour and outcomes. The comparison of model runs with different parameter values allows for a deeper understanding of the sensitivity of the model to impatience levels and other factors.