Timetabling at the University of Edinburgh

January 2026

1 Project Scope and Objectives

This study investigates the feasibility of modifying the University's teaching schedule policy. The primary objective is to determine whether the current timetable can be compressed without causin unsolvable clashes.

1.1 Proposed Scenarios

- **Scenario A (9-to-5):** Reduce core teaching hours to Monday–Friday, 09:00–17:00.
- **Scenario B (Friday Cut):** Eliminate teaching on Friday 12:00–18:00; keep Monday–Thursday 09:00–18:00 unchanged.

Key Research Questions

- Can core teaching be delivered within these reduced windows without clashes?
- Can a lunch break (12:00–14:00) be secured for the majority of students?
- How will these changes impact room utilization and scheduling density?

2 Data Sources and Constraints

The analysis relies on these datasets to define the *supply* (rooms), *demand* (events), and *conflicts or we may think as constraints* (programmes).

Event Data (`2024-5_Event_Module_Room.xlsx`)
: *Baseline Load Analysis.* Identifies events scheduled in "cut zones" (e.g., Mon 17:00–18:00 or Friday PM).

Room Data (`Rooms_and_Room_Types.xlsx`)
: *Supply Constraints.* Defines hard capacity limits for each room type.

Programme Structure (`Programme_Course.xlsx` / `DPT_Data`)
: *Hard Conflict Generation.* Compulsory courses for the same cohort cannot overlap.

Student Allocations (`Student_Programme_Module_Event.xlsx`)
: *Agent-Based Validation.* Enables simulation of individual student timetables to detect hidden clashes.

3 Methodological Framework

3.1 Constraint Satisfaction Problem (CSP)

The timetabling problem is modeled as a CSP:

- **Variables:** Teaching events (lectures, tutorials).

- **Domains:** Available time slots × available rooms.
- **Hard Constraints:** No room double-booking; no compulsory clashes; room capacity ≥ class size.
- **Soft Constraints:** Lunch breaks, travel minimization.

3.2 Optimization Pipeline

A *repair-and-reoptimize* simulation pipeline is proposed:

1. **Ingestion & Cleaning:** Normalize time formats and align event demand with room supply.
2. **Displacement:**
   - *Scenario A:* Unassign events scheduled at or after 17:00.
   - *Scenario B:* Unassign Friday events scheduled at or after 12:00.
3. **Reinsertion (Search Algorithms):**
   - **Meta-Heuristics (Tabu Search / Simulated Annealing):** Iteratively search for valid slots.
   - **Graph Coloring:** Early feasibility testing via conflict graph chromatic number.
4. **Hybrid Enhancement (Optional):** Reinforcement Learning to rapidly assess policy variants.

4 Success Criteria and KPIs

Tier 1: Feasibility (Hard Constraints)

- **Compulsory Clashes:** 0 overlapping compulsory events.
- **Room Capacity Violations:** 0 instances where $Event\_Size > Room\_Capacity$.
- **Unscheduled Classes:** Target = **0**.

Tier 2: Student Experience

- **Lunch Protection:** ≥ 1-hour continuous break between 12:00–14:00.
- **Compactness:** Reduced average daily teaching span.
- **Campus Continuity:** Minimized cross-campus travel per day.

Tier 3: Institutional Efficiency

- **Room Utilization:** 65% average utilization within core hours.
- **Bottlenecks:** Identification of room types reaching 70% saturation.

5 End Product and Deliverables

Proof of Concept (PoC)

This project delivers a **Proof of Concept (PoC)** (rather than a production-ready timetabling system). The primary outcome is a formal and computational demonstration of whether a compressed teaching timetable *can* or *cannot* exist under the proposed policy changes.

5.1 Primary Deliverables

- **Mathematical Feasibility Proof:** A formal characterization of the timetabling problem as a Constraint Satisfaction Problem (CSP), establishing necessary and sufficient conditions under which a feasible timetable exists for each scenario.
- **Algorithmic Tooling:** An executable optimization pipeline implementing feasibility checks (graph coloring) and meta-heuristic search methods (Simulated Annealing / Tabu Search) capable of constructing valid timetables when feasibility is theoretically attainable.
- **Scenario-Specific Timetables:** Concrete example timetables for each proposed scenario, or a certified infeasibility result when no such timetable exists.

5.2 Nature of the Result

- If a scenario is **feasible**, the PoC produces at least one valid timetable satisfying all hard constraints.
- If a scenario is **infeasible**, the PoC provides a **constructive proof of impossibility**, identifying the binding constraints (e.g., room capacity saturation or unavoidable compulsory clashes).