Problem Chosen	2025	Team Control Number
C	**MCM/ICM**	**1234**
	Summary Sheet	

A Ready-to-Use LaTeX Template for v6.3.3

Summary

Problem & Goal. TODO: Rephrase the problem in 1–2 sentences and state measurable goals; specify scope (who/where/when) and KPIs (e.g., cost, accuracy, coverage).

Method. TODO: Name the core model/algorithm and key ideas (e.g., conservation law / optimization / simulation); optionally cite the central equation or workflow.

Key Results. TODO: Report headline results with "numbers + units" (scenarios A/B/C with metrics X/Y/Z = . . .); add one sentence comparing to baseline/literature/common sense.

Validation. TODO: State consistency with historical observations / public benchmarks / expert ratings (error, correlation, or statistical significance).

Implications. TODO: Provide actionable recommendations (prioritized actions or cost–benefit trade-offs) in one concise sentence.

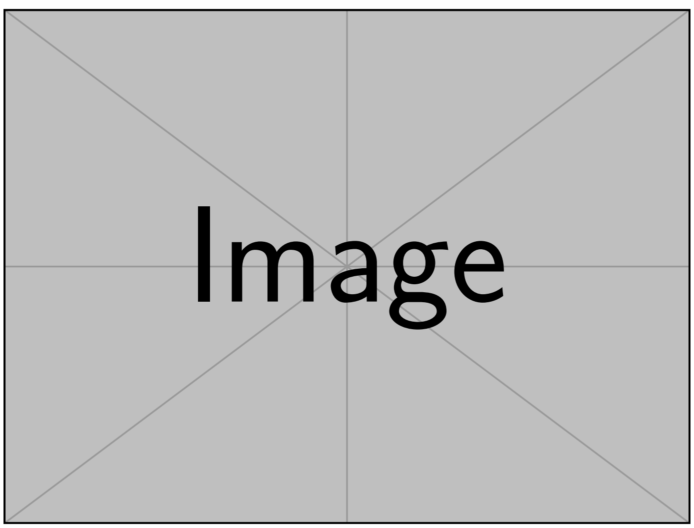

Figure 1: Main result at a glance (placeholder; replace with your overview figure)

Keywords: optimization; simulation; modeling; sensitivity analysis; decision making

Contents

1 Introduction & Goals

Background. We consider the effects of [PHENOMENON] over [TIME HORIZON] on [REGION/SYSTEM/STAKEHOLDERS]. This study is motivated by [CONTEXT & SIGNIFICANCE], where prior efforts have focused on [PRIOR FOCUS] yet a gap remains in [GAP/LIMITATION]. To make the problem concrete, we ask: (i) [SUB-QUESTION 1]? (ii) [SUB-QUESTION 2]? (iii) [SUB-QUESTION 3]? We use data from [DATA SOURCE(S)] collected during [DATA WINDOW] and summarize key variables in [TABLE/FIGURE REF]. To stress-test conclusions for decision-makers in [TARGET DOMAIN], we analyze [SCENARIOS/CASES] and report implications under [CONSTRAINTS/ASSUMPTIONS].

Goals & KPIs. Our goal is to [DESIGN/BUILD/PROPOSE] a [METHOD/SYSTEM] that: (a) [GOAL 1], (b) [GOAL 2], and (c) [GOAL 3]. We explicitly *exclude* [OUT-OF-SCOPE 1], [2], [3]. We evaluate success using pre-defined thresholds: [METRIC A] ≥ [THRESHOLD A], [METRIC B] ≤ [THRESHOLD B], and [METRIC C] within [RANGE], under [TIME/MEMORY/COMPUTE] constraints. The study scope includes [GEOGRAPHIC AREA/POPULATION], [APPLICATION SCENARIO], and the period [START DATE]–[END DATE].

1.1 Evaluation Metrics

We quantify performance along accuracy, efficiency, and coverage/cost dimensions:

Point/series accuracy. Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) are defined as

$$\mathrm{MAE} = \frac{1}{n}\sum_{i=1}^{n}\left|y_i - \hat{y}_i\right|, \qquad \mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(y_i - \hat{y}_i\right)^2}.$$

Classification quality. Given true positives (TP), false positives (FP), false negatives (FN),

$$\mathrm{Precision} = \frac{\mathrm{TP}}{\mathrm{TP}+\mathrm{FP}}, \quad \mathrm{Recall} = \frac{\mathrm{TP}}{\mathrm{TP}+\mathrm{FN}}, \quad \mathrm{F1} = 2\cdot\frac{\mathrm{Precision}\cdot\mathrm{Recall}}{\mathrm{Precision}+\mathrm{Recall}}.$$

We summarize the trade-off via the Precision–Recall Area Under Curve (PR–AUC) computed over the score threshold $\tau \in [0, 1]$.

Operational metrics. Coverage and cost are computed as

$$\mathrm{Coverage} = \frac{\text{served units}}{\text{eligible units}}, \qquad \text{Unit Cost} = \frac{\text{total cost (currency)}}{\text{output units}},$$

and we also report throughput (items/s) and latency (s) under [HARDWARE/SETTINGS].

We report all metrics with [CONFIDENCE LEVEL]% confidence intervals over [NUMBER] independent runs or [FOLDS]-fold cross-validation, and we conduct ablation on [KEY COMPONENTS] to assess robustness.

Metric	Definition / How computed	Why it matters	Targ
MAE	$\frac{1}{n}\sum_i \lvert y_i - \hat{y}_i \rvert$; scale-sensitive absolute error.	Penalizes average absolute deviation; robust to outliers.	$\leq$ [X
RMSE	$\sqrt{\frac{1}{n}\sum_i (y_i - \hat{y}_i)^2}$; square-penalized error.	Emphasizes large errors; useful for safety-critical tasks.	$\leq$ [X
Precision / Recall / F1	From TP/FP/FN as above, at threshold τ.	Controls false alarms vs. misses; F1 balances both.	$\geq$ [X
PR–AUC	Area under Precision–Recall curve over $\tau \in [0, 1]$.	Stable under class imbalance; summary of ranking quality.	$\geq$ [X
Coverage	$\frac{\text{served}}{\text{eligible}}$ over [REGION/TIME].	Measures service reach / fairness / access.	$\geq$ [X
Unit Cost	Currency per delivered unit.	Budget feasibility and scalability.	$\leq$ [$X
Latency / Throughput	End-to-end response time / items per second.	Real-time deployability and user experience.	$\leq$ [X

Table 1: Evaluation metrics, computation, rationale, and targets. Replace bracketed *[X]* with your thresholds.

Mini Glossary (EN-ZH)

scope spatial/temporal/population limits of the study.

constraint limits on time, memory, budget, or policy.

validation testing on held-out data or cross-validation.

benchmark a standard dataset/method used for comparison.

ablation removing components to isolate their effects.

assumption a stated condition required by the model.

sensitivity analysis vary inputs/params to test robustness.

robustness stability of results under perturbations/shifts.

coverage proportion of eligible items successfully served.

latency/throughput response time / processing rate.

2 Assumptions & Notation

2.1 Key Assumptions

- **TODO:** Assumption 1 (falsifiable and strongly tied to the model).
- **TODO:** Assumption 2.
- **TODO:** Assumption 3.

2.2 Notation Table

Symbol	Meaning / Unit
$i,\ j$	Row / column indices of the Sudoku grid (1–9).
(i, j)	Coordinate of a cell (row i, column j).
B	A Sudoku board (grid).
$S(B)$	Sudoku Solution Graph (SSG): candidate digits set attached to each cell of board B.
group	A row, a column, or a 3×3 region (box).
$X,\ Y,\ Z$	Cell variables (uppercase italic).
x	A digit value $(1-9)$.
(x, X)	Assignment: cell X takes value x.
$X^?$	Candidate set for cell X.
P	A Sudoku puzzle (board with some given digits).
$E(P)$	Set of empty cells in puzzle P.
$c(X) = \|X^?\|$	Choice function: number of candidates of cell X.
$\tilde{c}(P)$	Choice histogram (vector) of puzzle P.
$c_n(P)$	The n-th bin count of $\tilde{c}(P)$.
$w(n)$	Weight function applied to bin n when computing ease.
$\mathrm{wef}(P)$	Weighted ease function for P.
$\mathrm{wnef}(P)$	Weighted *normalized* ease function for P.
N	Number of DLX solutions requested when seeding a generator.
DLX	Knuth's Dancing Links (Algorithm X) solver for exact cover.
Δz	Sea-level change due to thermal expansion (cm).
ΔT	Change in global temperature (°C).
k	Diffusivity coefficient in upwelling–diffusion model.
$\mathrm{local}(t)$	Expected local sea-level rise at year t (cm).
$\mathrm{normalized}(t)$	Global sea-level rise estimate relative to historical rate (cm).
trend	Local historical rate of sea-level change (cm/yr).
$\mathrm{global}(t)$	Model-predicted global sea-level rise at year t (cm).
$S_1(t)$	Temperature-proportional sea-level component, $S_1 = \gamma\, \Delta T(t)$.
γ	Scaling $\gamma = \dfrac{\Delta S(2100)}{\Delta T(2100)}$.
$S_2(t)$	Heat-transfer component of sea-level rise.
q	Heat flux in generic heat-exchanger equation.
U_a	Thermal (convective) coefficient in heat-transfer term.
$T_1,\ T_2$	Temperatures of the two media in the heat-exchange model (°C).
$\alpha,\ \beta$	Scaling coefficients from integration / calibration of $S_2(t)$.
t_f	Final time (year) for the integration window.
$\Delta S(t)$	Total sea-level rise: $\Delta S(t) = 0.55\, S_1(t) + 0.45\, S_2(t)$ (cm).
ΔT_{Gr}	Greenland temperature change; $\Delta T_{\mathrm{Gr}} = 2.2\, \Delta T_{\mathrm{global}}$.
M	Mass balance of an ice sheet (accumulation − ablation).

3 Data & Sources

3.1 Datasets and Acquisition

TODO: Inventory datasets, time ranges/versions, acquisition method and license (public repositories, agency portals, etc.).

3.2 Preprocessing & Uncertainty

TODO: Describe missing-value handling, resampling/alignment, outliers, measurement error assumptions, and possible biases introduced.

Dataset	Time Range	Source URL/Ref	Notes
TODO: Name A	**TODO:** 2000–2024	**TODO:** Ref/Link	**TODO:** Resolution/License
TODO: Name B	**TODO:** ...	**TODO:** ...	**TODO:** ...

Table 3: Data inventory.

4 Model / Algorithm

4.1 Core Idea

TODO: Why this model: mechanistic interpretability / tractability / match to data. Refer to the overview in Fig. 2.

4.2 Mathematical Formulation

We formulate the problem as

$$\min_{\theta} J(\theta) = \sum_{i=1}^{n} \ell\big(f(\mathbf{x}_i;\theta),\, y_i\big) \quad \text{s.t.} \quad \mathbf{g}(\theta) \le \mathbf{0},\ \mathbf{h}(\theta) = \mathbf{0}. \tag{1}$$

TODO: Or provide differential/difference equations, constraints, and boundary conditions; include pseudocode/workflow if appropriate.

4.3 Complexity & Interpretability

TODO: State time/space complexity order; list key hyperparameters and their meanings; specify interpretability hooks (feature importance, sensitivity paths, etc.).

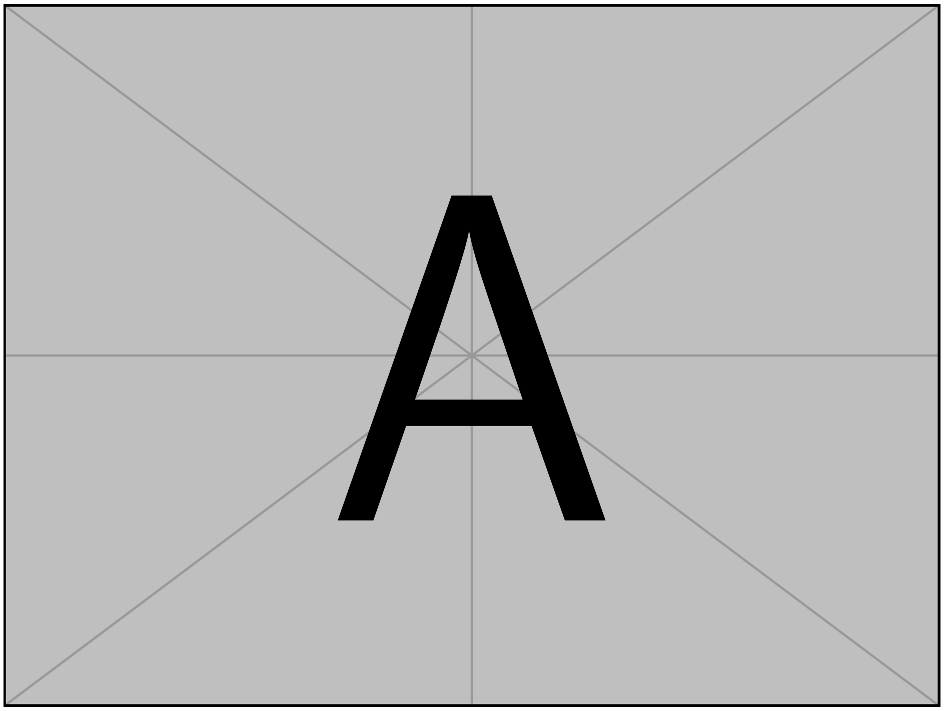

Figure 2: Workflow / model components (placeholder)

5 Computation / Implementation

TODO: Numerics (discretization, convergence/step size, stability), engineering (language/libs/hardware), and acceleration/robustness (pruning, caching, parallelism).

Listing 1: Pseudocode or key routine (placeholder)

```
# TODO: Replace with your algorithmic skeleton
for epoch in range(E):
    theta = update(theta, grad(J))
    if converged(theta): break
```

6 Results

TODO: Present primary figures/tables with quantitative conclusions. Aim for “number + unit + comparator” in every headline claim.

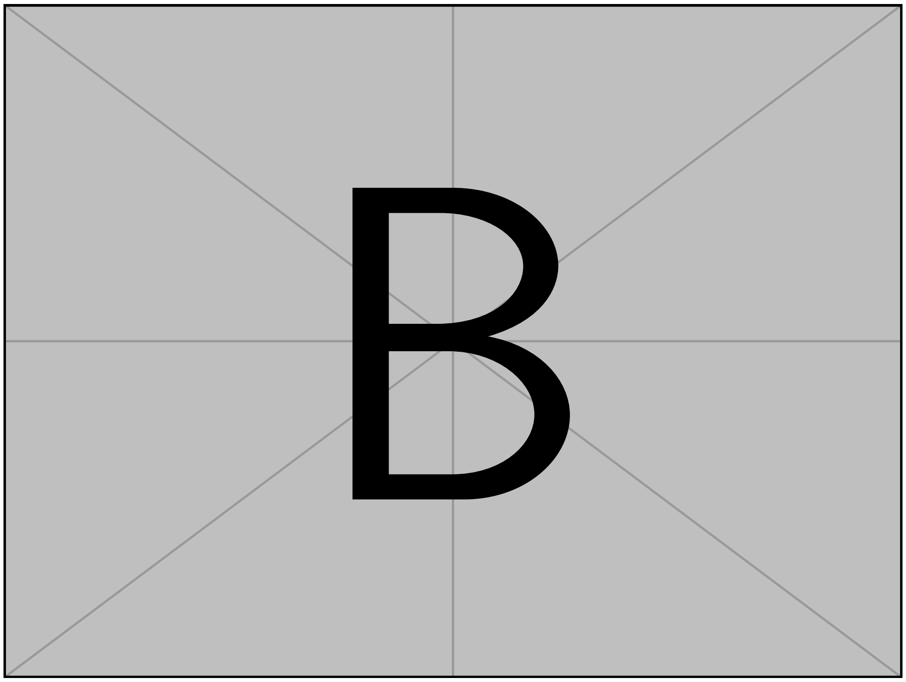

Figure 3: Main quantitative results under scenarios A/B/C (placeholder)

7 Validation

TODO: Check against history / third-party benchmarks / cross sources; report statistical significance or error bars.

$$\text{e.g., MAE} = \textbf{TODO: } \textit{value}, \quad r = \textbf{TODO: } \textit{value}, \quad p < 0.05.$$

8 Sensitivity Analysis

TODO: Perturb the most influential parameters (±10% / multi-scenario), show KPI variation (heatmap or tornado plot), and discuss robustness.

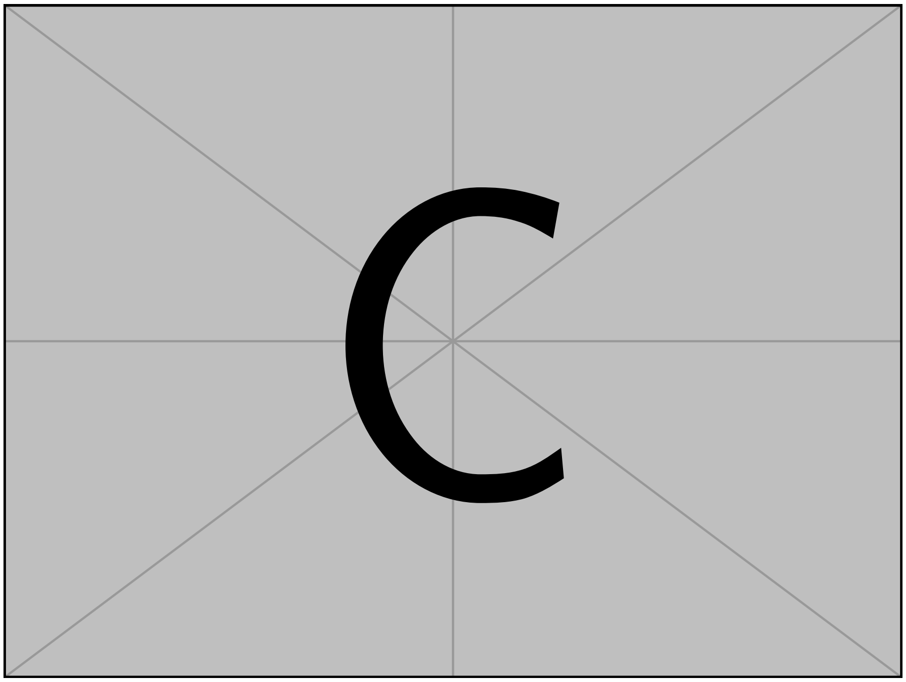

Figure 4: Sensitivity of KPI to key parameters (placeholder)

9 Strengths and Weaknesses

9.1 Strengths

- **Generality** — **TODO:** Applicable to multiple scenarios; scalable.
- **Interpretability** — **TODO:** Results are explainable and auditable.
- **Efficiency** — **TODO:** Complexity/runtime advantages and resource friendliness.

9.2 Weaknesses

- **TODO:** Data dependence / boundary conditions / extrapolation risks.
- **TODO:** Sensitivity to hyperparameters / scenario setup.
- **TODO:** Bias from simplifying assumptions.

10 Decision Recommendations

TODO: Actionable checklist for policy/engineering/operations with priorities, cost–benefit, and risks.

1. **TODO:** Action 1: expected benefit, cost, and prerequisites.
2. **TODO:** Action 2: ...
3. **TODO:** Milestones & evaluation: when/how to accept results.

11 Conclusion

TODO: Answer the original questions in 2–3 short paragraphs; restate contributions and applicability; outline future work. Cross-reference Eq. (1), Fig. 3, and Fig. 4.

12 Appendix

A. Derivations / Proofs

TODO: Move lengthy derivations here to keep the main text concise.

B. Additional Algorithms / Pseudocode

Listing 2: Example (inline)

```python
def selection_sort(arr):
    for i in range(len(arr)):
        m = i
        for j in range(i+1, len(arr)):
            if arr[j] < arr[m]:
                m = j
        arr[i], arr[m] = arr[m], arr[i]
    return arr
```

C. Extra Figures and Tables

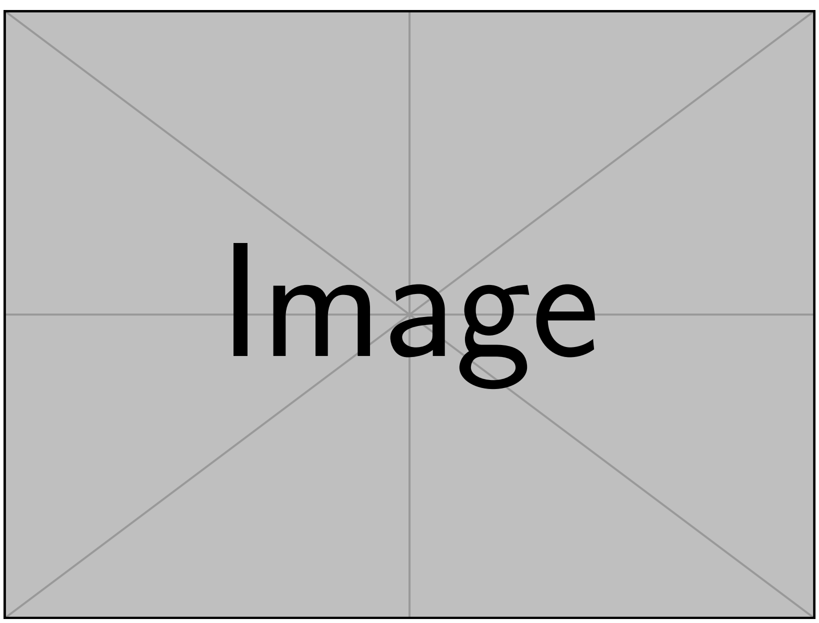

Figure 5: Additional visualization (placeholder)

References

[1] D. E. Knuth, *The TeXbook*, Addison–Wesley, 1984.

[2] L. Lamport, *LaTeX: A Document Preparation System*, Addison–Wesley, 1986.