Writing Classes for Mathematical Modeling Competitions
W5: Visual Evidence, LaTeX, and Submission Engineering

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Learning goals

By the end of this two-hour writing class, students should be able to:

- treat equations, tables, figures, captions, and page layout as parts of an evidence argument rather than decoration;
- choose deliberately among prose, equation, table, plot, schematic, map, and algorithm display;
- create a visible page hierarchy that supports both rapid scanning and careful verification;
- typeset equations with definitions, punctuation, numbering, and cross-references that remain stable during revision;
- design tables with units, meaningful precision, uncertainty, and an explicit comparison target;
- select a plot type that matches the analytical question and avoid misleading axes, encodings, and scales;
- write captions that identify the display, explain its encoding, state the main finding, and connect it to the decision;
- distinguish a reproducible figure pipeline from late-stage manual formatting;
- organise a standalone, Overleaf-safe LaTeX project with predictable file names and no fragile external dependencies;
- construct a page budget and a contest-specific rule card before writing begins;
- perform content, visual, technical, anonymity, provenance, and submission preflight checks;
- package one modeling result into a competition-ready page containing prose, mathematics, a visual, and a decision statement.

1 A visual is an evidence claim, not a decoration

The reader never sees the team's calculations directly. The reader sees a sequence of selected objects on a page: sentences, equations, tables, plots, captions, and references. Each object should help the reader answer one of three questions:

1. What did the team model or compute?
2. What evidence supports the claim?
3. What decision follows from the evidence?

A polished page is therefore not merely attractive. It is an interface for verifying the argument.

Launch activity: same evidence, different page

Both drafts report the same result from an illustrative synthetic school-bus case: four buses, 87 km of daily routes, mean ride time reduced from 43 to 28 minutes, and a fifth bus required above 240 riders.
Draft A contains a dense paragraph, an unlabeled screenshot, and a table with columns named "A," "B," and "C."
Draft B opens with the headline result, displays a route-time comparison with units, labels the threshold at 240 riders, and uses a caption to explain why the threshold matters.
In pairs, list the evidence that is technically present in Draft A but practically inaccessible. Then identify the page features that make Draft B faster to inspect without changing the underlying mathematics.

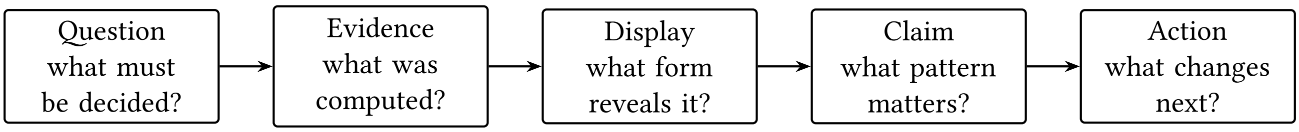

Figure 1: The visual evidence chain. A display is successful only when its form reveals the evidence needed for a claim and the claim supports a decision.

Visual communication standards

A competition display should be:

1. **Necessary**: it answers a question more efficiently than prose alone.
2. **Interpretable**: labels, units, symbols, scales, and encodings are defined.
3. **Traceable**: the text refers to it and the display can be linked to data, equations, or code.
4. **Honest**: the scale and selection do not exaggerate or conceal differences.
5. **Decision-connected**: the caption or surrounding prose states why the pattern matters.

2 Choose the representation before formatting it

A common failure is to choose a display because it is visually impressive. The correct choice begins with the reader's task.

Representation by reader task

Reader task	Usually use	Reason
Understand one relationship	Equation plus prose	Exposes variables, assumptions, and mathematical structure.
Compare exact values	Table	Preserves numbers, units, rankings, and thresholds.
See a trend or shape	Line/scatter plot	Reveals direction, curvature, clusters, and departures.
Compare categories	Ordered dot/bar plot	Supports magnitude comparison from a common baseline.
Understand a process	Flowchart or state diagram	Shows sequence, dependencies, states, or information flow.
Understand geography/network	Map or network diagram	Preserves location, connectivity, and route structure.
Inspect uncertainty	Interval plot, distribution, fan chart	Shows range, variation, or probability rather than a single estimate.
Follow an algorithm	Pseudocode or numbered method	Makes logic auditable without exposing implementation detail.

Method: the representation test

Before creating a visual, complete four sentences:

1. The reader needs to compare / locate / understand / decide ____________________.
2. The evidence consists of ______________________________.
3. A _______________ is better than prose because _________________________.
4. After seeing it, the reader should conclude ______________________________.

If sentence 4 cannot be completed, the display has no defined analytical purpose.

Example 1: table or figure?

Suppose five routing methods are compared using total distance, maximum ride time, computation time, and number of constraint violations.

- Use a **table** when the reader must inspect all four exact metrics and identify whether each method satisfies a threshold.
- Use a **plot** when the argument concerns one trade-off, such as total distance versus maximum ride time.
- Use both only when they perform different jobs: the plot reveals the trade-off; the compact table records the selected method's exact values.

Repeating the same data twice merely consumes the page budget.

Checkpoint: Checkpoint: choose, do not decorate

Choose one representation and justify it.

1. Four models, each with MAE, RMSE, and training time.
2. A queue length recorded every minute for four hours.

3. A six-stage simulation procedure.
4. Route connections among 18 school stops.
5. A recommendation that changes when demand exceeds 240 riders.

More than one answer may be defensible, but the reader task must be explicit.

3 Design a page for scanning and verification

Competition readers alternate between two modes. In **scan mode**, they locate the headline answer, section purpose, key visual, and caption. In **verification mode**, they inspect definitions, equations, numerical details, and limitations. A strong page supports both.

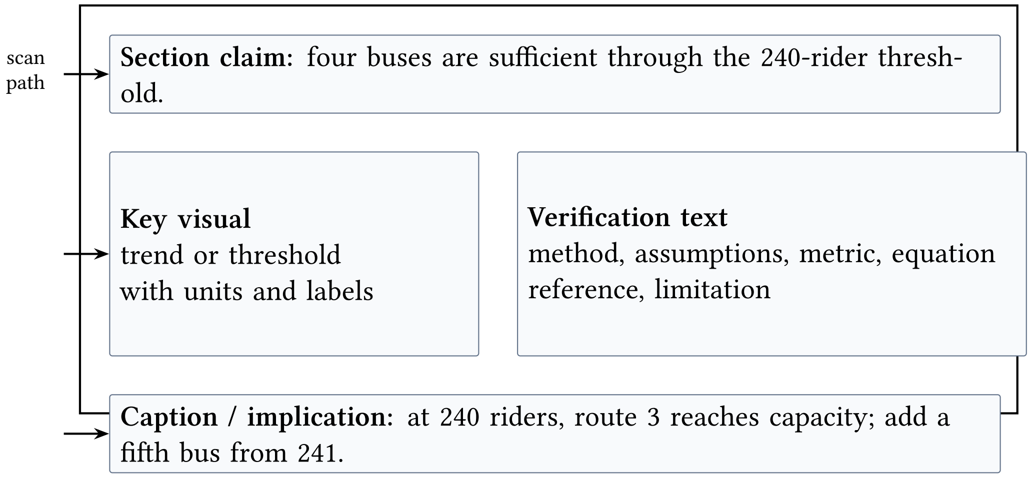

Figure 2: A page hierarchy that supports two reading modes. The section claim and caption carry the scan path; the display and explanatory text support verification.

Method: page-level hierarchy

Use hierarchy through meaning, not through decoration.

1. Give each section a claim-oriented title when possible: "Demand uncertainty changes the fleet decision" is more informative than "Sensitivity Analysis."
2. Place the key display near the paragraph that introduces it; avoid orphan figures several pages later.
3. Use bold text for a small number of decision-critical results, not for entire paragraphs.
4. Keep heading levels consistent. A paper rarely needs more than three levels.
5. Preserve white space around sections and displays; do not fill every centimetre with text.
6. Keep the same visual grammar throughout: font, line weight, caption style, decimal precision, and notation.

Model criticism: Do not confuse page density with mathematical depth

Shrinking margins, font size, captions, or plots does not create a stronger solution. It increases search cost and may violate the rules. Page limits should be managed by removing duplication, compressing derivations, and prioritising decision evidence – not by making the paper physically difficult to read.

4 Equations must function as sentences

An equation is not self-explanatory. The prose should state why it is introduced, define its symbols, and explain what feature of the real system it represents.

Method: purpose–equation–definition–interpretation

A reliable equation paragraph has four parts:

1. **Purpose**: what quantity or mechanism is being modeled?
2. **Equation**: display the relationship and number it if later referenced.
3. **Definition**: define all new variables, parameters, indices, and units near first use.
4. **Interpretation**: state what the equation captures, and when useful, what it omits.

Example 2: a readable model equation

To evaluate a routing plan, we combine total distance with a penalty for capacity violations:

$$J(\mathcal{R}) = \sum_{r\in\mathcal{R}} d_r + \alpha \sum_{r\in\mathcal{R}} \max\{0, n_r - C\}, \tag{1}$$

where $\mathcal{R}$ is the set of bus routes, d_r is route distance in kilometres, n_r is assigned ridership, $C = 60$ is bus capacity, and α is a penalty measured in kilometres per excess passenger. The first term rewards short routes; the second makes capacity violations costly. Because α is a modeling choice rather than a measured physical constant, we test its influence in the sensitivity analysis.

Equation and notation rules

- Number only equations that will be referenced or form part of a derivation.
- Use stable labels such as `eq:route-objective`, not manual numbers.
- Refer to equation (1), not "the equation above."
- Do not reuse a symbol for different concepts. If r denotes a route index, do not later use r as a growth rate.
- State units when a quantity first appears and preserve dimensional consistency.
- Punctuate displayed equations as parts of sentences.
- Move long algebraic manipulations to an appendix when the body only needs the setup and the result.

Listing 1: A stable equation and cross-reference pattern.

```
To penalize infeasible routes, we define
\begin{equation}
  J(\mathcal{R}) = D(\mathcal{R}) + \alpha V(\mathcal{R}),
  \label{eq:objective}
\end{equation}
where $D$ is total distance and $V$ is the number of
capacity violations. As shown in \cref{eq:objective}, ...
```

Checkpoint: Checkpoint: repair the equation paragraph

"We use the following formula: $Q = ab/c$. Here are the results."
Revise it so that the reader knows the purpose of Q, the meaning and units of a, b, c, the origin of the form, and the implication of the computed value.

5 Tables should expose comparisons and thresholds

A table is strongest when exact numbers matter. The design should make the intended comparison visible without forcing the reader to decode formatting.

Method: table design checklist

1. State the comparison question in the caption.
2. Put units in headers and define the evaluation set or scenario.
3. Align numbers consistently; use meaningful rather than excessive decimal places.
4. Include a baseline, target, tolerance, or benchmark when a decision depends on comparison.
5. Display uncertainty when the values are estimates, not exact constants.
6. Order rows by analytical meaning: chronology, rank, model complexity, or influence.
7. Use notes for exceptions, not unexplained symbols inside cells.
8. Do not reproduce every raw output. Select the evidence needed for the claim.

Example 3: a decision table

Table 1: Fleet requirement across ridership scenarios. The four-bus plan remains feasible up to 240 riders; the recommendation switches to five buses above that threshold.

Ridership	Buses required	Maximum load	Decision interpretation
220	4	54	Four buses feasible with six-seat margin.
230	4	57	Feasible, but limited reserve capacity.
240	4	60	Capacity boundary; monitor enrollment.
250	5	51	Fifth bus required to restore capacity margin.
260	5	54	Five-bus plan remains feasible.

The table supports a conditional recommendation rather than the vague statement that "four buses are robust."

Precision is part of the claim

Report precision that the data and method can support.

- A commute estimate of 28.37 min suggests false precision if input travel times were recorded to the nearest minute.
- A relative error of 2.1% is more interpretable when the comparator and sample are stated.
- A mean without a spread can hide instability. Consider a range, standard deviation, confidence interval, or scenario count.
- A percentage requires a denominator: "12% lower than the baseline four-route plan," not merely "12% lower."

Model criticism: Table failure modes

Avoid vertical rules, merged-cell mazes, tiny fonts, unexplained abbreviations, units repeated in every cell, inconsistent decimal places, and bolding every row. These features make the table look busy without improving the comparison.

6 Figures should answer one analytical question

Figures are efficient for patterns, relationships, uncertainty, and spatial structure. They become misleading when the encoding is selected after seeing which form makes the result look most impressive.

Plot selection by analytical question

Question	Preferred display	What to show
How does a quantity change over time?	Line plot	Time units, intervention markers, uncertainty if estimated.
Are two variables associated?	Scatter plot	Individual observations, fitted relation, residual/uncertainty information.
Which category is larger?	Ordered dot/bar plot	Common zero baseline when magnitude is the claim.
Where is a decision threshold?	Line/step plot with threshold	Boundary value, feasible and infeasible regions, direction of recommendation.
How variable is an output?	Histogram, density, interval, box plot	Sample size, centre, spread, tails, and relevant target.
How do two parameters interact?	Contour/heatmap	Legend, scale, feasible region, selected operating point.
How is a system connected?	Network or state diagram	Node/edge meaning, direction, weight, and selected path/state.

Example 4: an honest threshold figure

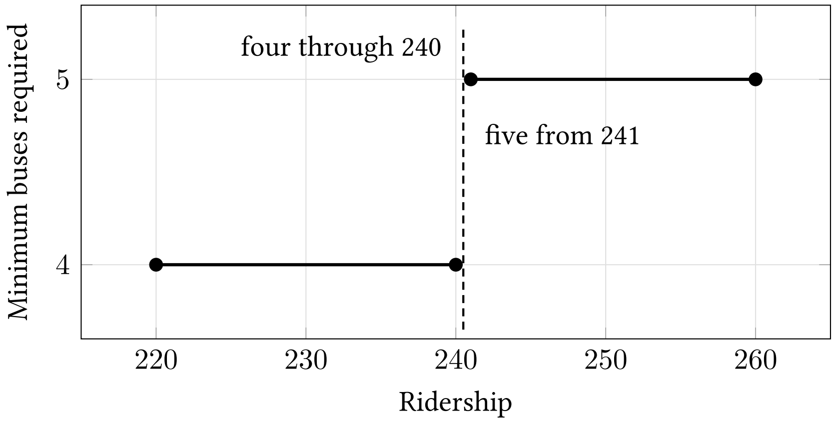

Figure 3: Minimum fleet size across tested demand scenarios. Four buses satisfy capacity through 240 riders; the requirement increases to five above the boundary. The figure therefore supports an enrollment-trigger recommendation rather than a single unconditional fleet size.

Method: figure integrity audit

Ask six questions before export:

1. Are axes, units, categories, symbols, and sample sizes defined?
2. Does the scale reveal the pattern without exaggerating it?
3. Is uncertainty shown when the line or point is estimated?
4. Can curves or categories still be distinguished in greyscale?
5. Is the important comparison visually direct, or must the reader subtract values mentally?
6. Does the caption state the finding and decision implication?

Model criticism: Frequent misleading choices

- Truncating a bar-chart axis to magnify a small difference.
- Using a dual y-axis that creates an apparent correlation through arbitrary scaling.
- Connecting unordered observations with a line.
- Showing only a fitted curve and hiding the underlying observations.
- Using a pie chart for many similar categories that require precise comparison.
- Using a rainbow scale whose order is unclear in greyscale.
- Presenting one simulation path as if it were the distribution of possible outcomes.

Checkpoint: Checkpoint: caption surgery

Revise “Figure 5. Results of the simulation.” A complete caption should answer:

1. What is displayed and under which scenario?
2. What do lines, points, shading, or panels encode?
3. What is the main numerical or structural finding?

4. What model or decision implication follows?
5. What condition or limitation should the reader remember?

7 Build a reproducible document, not a fragile final file

The document should be regenerable from source. Manual copying, unnamed screenshots, and late-stage editing inside the PDF destroy traceability and create inconsistencies.

Method: a reliable project structure

```
project/
|-- main.tex
|-- references.bib
|-- sections/
|   |-- 01_introduction.tex
|   |-- 02_model.tex
|   |-- 03_results.tex
|   `-- 04_validation.tex
|-- figures/
|   |-- fleet_threshold.pdf
|   `-- route_map.pdf
|-- data/
|   `-- processed_routes.csv
|-- code/
|   |-- build_tables.py
|   `-- make_figures.py
`-- submission/
    `-- CONTROLNUMBER.pdf
```

Each final table or figure should have a known source. Keep raw data separate from processed data, and keep the submission PDF separate from working files.

A reproducible figure pipeline

1. Store the cleaned data or documented inputs.
2. Generate the figure with a named script or a stable TikZ block.
3. Export to vector PDF for line art whenever possible; use high-resolution raster only for inherently raster images.
4. Insert the exported file at a controlled width.
5. Record the script, parameters, and date or commit that generated it.
6. Regenerate all displays after any numerical change; do not edit the labels manually afterward.

Listing 2: A short, stable figure insertion pattern.

```
\begin{figure}[tbp]
  \centering
  \includegraphics[width=0.78\textwidth]{figures/fleet_threshold.pdf}
  \caption{Minimum fleet size across tested demand scenarios. ...}
  \label{fig:fleet-threshold}
\end{figure}
```

```
As shown in \cref{fig:fleet-threshold}, the decision changes ...
```

Model criticism: TikZ and competition reliability

TikZ is excellent for small mathematical diagrams whose text must match the paper. It is not automatically the best tool for every map, network, or data plot. Complex TikZ can slow compilation and is difficult to repair under deadline pressure. Prefer:

- simple fixed-node diagrams in TikZ;
- data plots generated from code and exported as PDF;
- no labels placed by trial-and-error over curves when a legend or external annotation is clearer;
- a rendered-page inspection after every substantial visual change.

A figure that compiles is not necessarily a figure that communicates.

Cross-references and bibliography

- Label every referenced equation, table, figure, and section.
- Use `\cref` or equivalent commands instead of typed numbers.
- Cite a source at the claim it supports; do not place a list of unrelated citations at paragraph end.
- Record authorship, title, year, publisher/journal, DOI or stable source, and access date when appropriate.
- Keep one citation style throughout. Consistency matters more than choosing between APA and IEEE.
- Check that every citation appears in the bibliography and every bibliography entry is cited.

Provenance and AI-use disclosure

A submission should make the origin of data, code, images, external text, and AI-assisted work clear. Current contest rules can differ, and the team must read the official instructions for the exact year and round. For example, the 2026 HiMCM instructions require teams that use LLMs or other AI tools to identify the model and purpose, cite the use in the report and references, and append a separate AI-use report. The report is not a substitute for checking every generated statement, citation, calculation, and code result.

8 Submission engineering begins before the competition

Submission failure is often a process failure rather than a mathematical failure. Teams should convert the official rules into a one-page **rule card** before creating the template.

Method: build a contest rule card

Record only information taken from the official instructions for the current year and round:

- paper size, font minimum, margin minimum, language, and anonymity requirements;
- required first pages, letters, graphics, or summary forms;
- page limit and whether contents, references, appendices, and AI reports count;
- required header/footer, team number, and page numbering;

- accepted file type, size limit, file name, and number of uploads;
- work-stop time, submission deadline, time zone, and who may submit;
- AI-use, data, code, and external-resource disclosure rules.

Do not copy a rule card from a different competition or year. In 2026 HiMCM, for example, the Summary Sheet plus solution, references, and appendices are limited to 25 pages, whereas the required AI-use report is appended outside that limit. IM^{2}C requirements may be round- and problem-specific, so the official problem statement must also be checked.

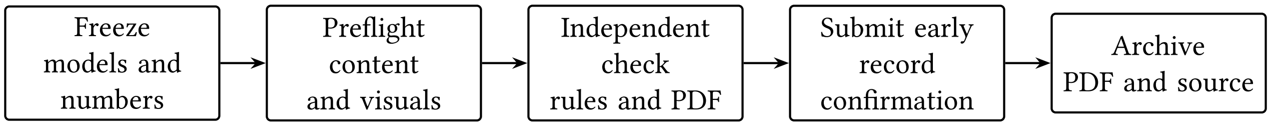

Figure 4: Submission engineering is a controlled pipeline. New analysis should not be introduced after the freeze unless it repairs a critical error.

Method: six-part preflight

1. **Content**: every task answered; headline results agree across summary, body, tables, and conclusion.
2. **Mathematics**: symbols defined; units consistent; equations, code outputs, and tables cross-checked.
3. **Visual**: captions complete; labels readable at page size; no overlap, clipping, or unexplained encodings.
4. **Technical**: clean compile; no unresolved references; correct page count; PDF opens on another device.
5. **Compliance**: anonymity, header, file name, AI disclosure, and current rule card satisfied.
6. **Submission**: correct portal and file; upload confirmed before the deadline; confirmation saved.

Model criticism: Final-hour anti-patterns

Do not introduce a new model, change the notation globally without recompiling, paste figures from chat screenshots, rebuild the bibliography manually, compress the PDF without checking glyphs, or wait for the final minutes to upload. A team should submit the best verified version, not the newest unverified version.

9 Integrated studio: build one competition-ready results page

Use the continuing school-bus evidence package from W2–W4:

- baseline mean ride time: 43.00 min; optimized mean: 28.00 min;
- four buses and 87.00 km of daily routes;
- four buses feasible through 240 riders; five required above 240;
- held-out route-time MAE: 2.40 min;
- route 3 is the binding route near the threshold.

Studio task: page blueprint

Create a one-page blueprint containing:

1. a claim-oriented subsection heading;
2. a two- to four-sentence results paragraph using the W4 paragraph arc;
3. one equation or compact method statement explaining the fleet decision;
4. one display: either table 1 or figure 3;
5. a caption that states the threshold and decision implication;
6. one limitation or condition;
7. one cross-reference to validation or sensitivity evidence.

The result should be understandable in scan mode and defensible in verification mode.

Example 5: model page text

Four buses remain sufficient through 240 riders, with an early review at 236. The optimized plan uses four buses and 87.00 km of daily routes, reducing mean ride time from 43.00 min to 28.00 min. Capacity tests show that the plan remains feasible through 240 riders but requires a fifth bus above this level (figure 3). Because route 3 reaches 60 passengers at the boundary, we recommend four buses for current demand and an early fleet review at 236 projected riders and a mandatory fifth bus from 241 riders.

The threshold is supported by capacity constraints rather than by the route-time prediction alone. Held-out route-time MAE is 2.40 min, but clustered changes in stop-level demand could move the boundary; the school should therefore update the assignment after major enrollment or residential-pattern changes.

Checkpoint: Peer audit: 90 seconds

Exchange page blueprints. Without asking the writer, record:

1. the recommendation;
2. the numerical evidence;
3. the decision threshold;
4. the main limitation;
5. where the reader would verify the method.

Anything your partner cannot locate in 90 seconds requires redesign, not merely proofreading.

10 Differentiated writing and production studio

Core route: repair a weak visual package

You are given a screenshot of an unlabeled line plot and a table with no units. Rebuild the package by supplying:

1. an analytical question;
2. a suitable display type;

3. labels and units;
4. a complete caption;
5. a two-sentence interpretation;
6. the source or script needed to reproduce it.

Challenge route: choose between competing displays

For a sensitivity analysis with five parameters and a binary recommendation, design two alternatives:

1. a tornado-style ranking of local effects;
2. a threshold/scenario table showing when the recommendation switches.

Explain which belongs in the main body and which, if either, belongs in an appendix. Your decision must refer to the paper's claim, not visual preference.

Extension route: design a reproducible production pipeline

Create a project plan that turns raw data into the final PDF. Specify:

- input files and validation checks;
- scripts that create tables and figures;
- naming conventions and output folders;
- how numerical updates propagate to the Summary and Conclusion;
- versioning, backup, and final-archive procedure;
- who performs the independent PDF and rules check.

Test the pipeline by changing one input value and regenerating every affected output.

Exercise W5.1: caption laboratory

Write a complete caption for each item:

1. observed and predicted commute times for 12 held-out days;
2. a sensitivity heatmap whose recommendation changes near $\lambda/\mu = 1$;
3. a route map with three candidate corridors and one selected route;
4. a convergence plot comparing Euler, Heun, and RK4;
5. a residual plot showing increasing variance at large fitted values.

Each caption must identify the display, state the main finding, and give the modeling implication.

Exercise W5.2: page-budget audit

Take a previous practice paper and classify every half-page as one of:

- task completion;
- model development;
- evidence/results;
- validation/sensitivity;

- recommendation/communication;
- duplication or low-priority detail.

Remove or move at least one page of duplication without shrinking the font or margins. Record what evidence, if any, was lost.

Exercise W5.3: mock submission

Run a 45-minute drill. Starting from a working project:

1. change one result and regenerate the affected table and figure;
2. update the Summary and Conclusion;
3. compile and inspect every page;
4. apply the rule card and preflight checklist;
5. rename the final PDF using a mock control number;
6. open it on a second device and place it in the submission folder;
7. record the time required for each stage.

Any stage that cannot be completed reliably becomes a training target.

11 Closing the writing sequence

W1–W5 evidence architecture

1. **W1 – Architecture:** help the reader locate the problem, model, evidence, and conclusion.
2. **W2 – Summary:** compress the task, strategy, findings, trust evidence, and decision.
3. **W3 – Trust:** expose assumptions and test the model through verification, validation, sensitivity, and uncertainty.
4. **W4 – Prose:** turn claims and evidence into calibrated, coherent paragraphs.
5. **W5 – Visual production:** present the evidence in inspectable displays and deliver a compliant, reproducible PDF.

The classes are not separate cosmetic layers. Together they form a single evidence system.

Class W5 take-aways

1. Begin every display with a reader question and end it with a decision implication.
2. Use tables for exact comparison and figures for pattern, relationship, uncertainty, process, or space.
3. Design for scan mode and verification mode on the same page.
4. Introduce equations through purpose, definition, and interpretation.
5. Precision, units, baselines, uncertainty, and thresholds are part of the claim.
6. A caption is a miniature evidence paragraph, not a label.
7. Reproducibility and cross-references reduce final-hour errors.

8. Contest rules change; create the rule card from current official instructions.
9. Compile, render, inspect, and independently verify the final PDF.
10. Submit the best verified version early, then archive both PDF and source.

Appendix A: Standalone competition-paper starter

```
\documentclass[12pt,a4paper]{article}
\usepackage[margin=2.5cm]{geometry} % replace only if rules require
\usepackage{iftex}
\ifPDFTeX\errmessage{Compile with XeLaTeX}\fi
\usepackage{fontspec,xeCJK}
\setmainfont{TeX Gyre Termes}
\setCJKmainfont{Noto Serif CJK TC}
\usepackage{amsmath,amssymb,graphicx,booktabs,array}
\usepackage{caption,subcaption,float,hyperref,cleveref}
\usepackage{siunitx}
\hypersetup{colorlinks=false,pdfborder={0 0 0}}

\begin{document}
% Insert the official current-year Summary Sheet or required first page.
% Do not include names or institution if anonymity is required.

\section{Introduction and Task Interpretation}
\section{Assumptions and Notation}
\section{Model Development}
\section{Results and Recommendation}
\section{Verification and Validation}
\section{Sensitivity and Limitations}
\section{Conclusion}

% Bibliography and appendices must follow the current contest rules.
\end{document}
```

Appendix B: Caption and display checklist

- ☐ The display answers one identifiable analytical question.
- ☐ Every axis, unit, category, symbol, panel, line, and shading convention is defined.
- ☐ The scale and data selection are honest.
- ☐ Estimated quantities show appropriate uncertainty or scenario scope.
- ☐ Text remains readable at final page size and in greyscale.
- ☐ The body refers to the display by number and states why it is introduced.
- ☐ The caption identifies the object and scenario.
- ☐ The caption states the main finding, not merely the axes.
- ☐ The caption links the finding to a model choice or decision.
- ☐ The display can be regenerated from a known source.

Appendix C: Final PDF and submission checklist

- ☐ Every task in the problem statement is answered and easy to locate.
- ☐ Summary, main text, tables, figures, and conclusion use the same final numbers.
- ☐ Units and notation are consistent; important equations are checked independently.
- ☐ No unresolved citations or cross-references remain.
- ☐ No text, table, figure, caption, or label is clipped or overlapping.
- ☐ Fonts are embedded and Chinese/English glyphs render correctly.
- ☐ Page count and all current-year rules are satisfied.
- ☐ Team number, page numbers, anonymity, and required first pages are correct.
- ☐ References, data sources, code, figures, and AI use are disclosed as required.
- ☐ File type, file size, and file name match the official instructions.
- ☐ The PDF opens and renders correctly on a second device.
- ☐ A non-author has completed the rule-card and visual inspection.
- ☐ The correct file has been submitted early and confirmation has been saved.
- ☐ Final PDF, source, data, code, and confirmation are archived together.

Appendix D: Current-rule source note

The 2026 HiMCM examples in this class are based on COMAP's official HiMCM/MidMCM instructions. The official 2026 IM^{2}C international-round page likewise states that teams must also follow the current problem-specific requirements. Teams in any competition should consult both the current rules and the current problem statement because required document components can differ by round and problem. Rules should be rechecked immediately before each competition.

References

[1] COMAP, "2026 HiMCM/MidMCM Instructions," checked 20 August 2026.

[2] IM^{2}C, "Challenge Overview," checked 20 August 2026, `https://immchallenge.org/immc-challenge/`.

Model audit card

Audit before trusting or communicating a model

Purpose	What question or decision does the model support?	**Data**	Which inputs are observed, derived, or simulated?
Assumptions	Which simplifications may change the answer?	**Units**	Are dimensions and scales consistent?
Verification	Were equations, code, constraints, and limiting cases checked?	**Validation**	Is performance tested against independent evidence?
Uncertainty	How do measurement, parameter, solver, and structural errors affect conclusions?	**Ethics**	Who benefits, who bears risk, and what fairness criterion matters?
Reproducibility	Are data provenance, versions, seeds, and transformations recorded?	**Communication**	Are claims conditional, traceable, and decision-relevant?

Further reading

- HiMCM / MidMCM Contest Instructions (COMAP)
- IM²C challenge overview and modeling expectations (International Mathematical Modeling Challenge)
- Create Graphics for Your Article (IEEE Author Center)
- LaTeX documentation (The LaTeX Project)

Sources, provenance, and licence

These notes follow the iterative modeling and assessment perspective in the SIAM/COMAP GAIMME report. Competition-specific remarks are a snapshot checked on 20 August 2026 against the official COMAP HiMCM instructions; readers should verify current rules before submission. Unless a source is explicitly identified, classroom datasets and numerical scenarios are synthetic or simulated teaching examples and are not empirical claims about a real institution. Third-party references retain their own terms.

Student response guide and checking criteria

For closed calculations, show the definition, substitution, units, and at least one independent check; the worked examples in this unit are method hints, but you must complete the arithmetic yourself. Open modeling responses are checked on five dimensions: a clear purpose and output; stated data and provenance; defensible assumptions and scope; traceable computational verification and model validation; and alignment among uncertainty, limitations, and the recommendation. Support each dimension with concrete evidence rather than writing only "completed."