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# Paper Writing Strategies

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*A good MCM paper should be divided into several sections.*

**Introduction:** The introduction is very important and requires extensive thought, careful crafting, and multiple revisions. The first sentence should be captivating, and should keep technical language and mathematical formulas to a minimum. Use them only when necessary.

First, you need to restate and clarify the problem. Clear up any ambiguities and tell the reader how you interpret the problem. If there are any key terms, define them in the manner you interpret them.

Once you restate the problem, search for published literature that involve similar problems, and talk about them a bit. Finally, describe BRIEFLY the methods you used to solve the problem and the results.

**Assumptions:** The assumption section should be a list of everything your model assumes to be true. Assumptions cannot be proven, you take them to be true. They may not even be true in real life, but your model subsists on the fact. In the Malthus, or boundless, growth model, we assume infinite space and resources, and no predatory competition. In the logistic growth model, we assume a lack of predatory influences and lack of immigration/emigration. Make sure to consider everything.

**Model:** Choosing the model is really important. Remember that the model is only a means to get a result. Keep the model simple. If you factor in too little variables, it may be inaccurate. Also, it is important to not factor in too many variables, as it complicates things. A simple model is a happy one. To take an extreme example, it probably is not important to include the percent of a population that has leg cramps, when modelling population growth.

A useful technique is to build series of models, each increasing in complexity. If my paper was on growth models, I would start off with the Malthus model, then the Logistical model, and then some other random, bit more complex one. But don't take the rocket to Mars and make a super complex model. Remember, a simple model is a happy one.

Also remember that a model should be general. Making it too specific to the problem is detrimental. First make a general algorithm for the class of problem, and then hone in on the specific instance.

**Conclusion:** The conclusion should include how you tested the model and what results you got. Remember, the model is not the answer, you must conclude something from the results. Make this conclusion first and easy to find.

It is also important to include how sensitive and stable your model is. Use slightly altered values as a test. Also include any code/algorithms/processes you used. Your methods and results should be reproducible.

Finally, include the strengths and weaknesses of the model, as well as any constraints you faced as the modeller.

**Summary:** A final thing to do is to write a summary sheet for the paper. The summary sheet is very important and is a major factor in deciding whether your paper is good enough. The summary should not be bland, it should be spicy. Do not regurgitate facts from the paper or copy-paste sentences. Use hooks and interesting language to draw the reader in. It should not be inundated with details, yet it should convey the greater idea of the paper, and your take on it. A summary paper should have:

- A restatement of the problem
- Assumptions
- Model and Justification
- Testing and sensitivity/stability analysis
- Strengths/Weaknesses

**Final Thoughts:** Once you write your paper, you are not done. The paper should be thoroughly revised. Each section should be sifted with a fine sieve. Each word should be molded for precision and accuracy. Make sure all the requirements are satisfied. Use interesting language and hooks to draw the reader in, but only use it when you are supposed to; do not over-do it and use it in places where it is unwarranted. Use the below sections as a guideline to correct grammatical/stylistic/syntax errors.

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# Style Tips

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**General Style:** Always use the word “we” when in need of a personal pronoun. Never say “I solve this equation” or “you should solve this equation,” but rather “we solved the equation.” The idea is that you are guiding the reader through your work.

Tense varies on what you are referring to. If you are discussing it now, use the present tense. If you discussed it in a past section, use the past tense. If you will discuss it later, use the future tense. Take the analogy of a manual:

“Attach the handle to the bike frame(something the reader should do now). We already assembled the handle parts in the last step(something you already discussed with the reader). We will install the braking system in the next step(something you intend to discuss in the future).”

Analogous to the bike example is a mathematical one:

“Solve for the variable Y. We solved for the variable X in the previous section. We will use the variables X and Y to solve for the variable Z next.”

Another tip is to use the active voice. Active voice is when the subject performs an action. Examples are “I throw the ball to Fred.” Passive voice is when the subject is the recipient of the action. Passive voice uses the verb “to be.” An example is “Fred was thrown the ball by me.” Passive voice is a weak construct, and it is always important to use the active voice.

**Simplicity:** It is essential to keep the paper simple. Avoiding convoluted structure makes it easier to read.

Sentences should be simple and only convey one idea. Avoid unnecessary phrases and clauses in the sentence. Break up complex sentences when possible. One will not be graded on the structure variety of one’s sentences.

Paragraphs should be short and convey a message after which the reader should have time to capitulate. Long paragraphs throw too much information at the reader, while paragraphs too short will make the flow too choppy.

**Word Choice:** Words must be chosen to convey a specific, unambiguous meaning. They should be specific and concrete, not an obscure word found in a thesaurus. Replace weak words like *expression* or *term* with words like *equation* or *variable* or *constant*.

**Unnecessary Content:** Avoid it.

As stated before, unnecessary transition words, phrases, and clauses should be expunged; opt for more concise phrasing. Replace weaker verbs with stronger verbs (replace *to make a carving* with *to carve*, for example). However, do not cut out words essential to grammatical structure. A common error is to omit the *that* between two clauses.

Although we should make the essay as concise as possible, do not simplify it to the point of sounding like an automaton. Do not repeat the same phrasing over and over again, yet you should vary it a little. Do not inject dramatic flair into it. The overall phrasing should be variable, but still concise.

Keeping with the spirit of conciseness, it is important not to inundate the reader with too many details. *I opened my computer. I started Matlab. I entered the data. I waited.* Too many details strays the reader's attention from the main point. In the end, it is your call in determining what is trivial and what isn't.

**Important Stuff:** If there are any important stuff, make sure it is visible. The assumptions can be bulleted. Any other important sentences **can be written in a bold font**.

However, in general, it is best not to overstate results. Judges are called judges for a reason, they judge the importance of the results. To say "*my work is such that the world will never be the same,*" to take an extreme case, severely decreases your credibility and appearance.

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# Grammar Rules

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**Spelling:** This goes without saying, but spelling is imperative. Look up a list of commonly misspelled words, it is easy to confuse *affect* and *effect*.

## **Verbs**

*Agreement:* Singular nouns must have plural verbs and plural nouns must have singular verbs. Two nouns conjoined with an *and* take on a plural verb, while two nouns conjoined with an *or* take on a singular verb. Collective nouns have singular verbs. Verbs referring to units of measurement is singular (*10 gallons IS a lot.*) When determining whether the verb is singular or plural, ignore any phrases, because it is only the subject that matters.

*Tense:* Tense is important to maintain in the paper. See *Paper Style* for more details

**Pronoun-Antecedent Agreement:** Pronouns should have a clear *antecedent* or word it is referring to. In the sentence “Fred and Bob are working on his project,” we do not know if the project is Fred’s or Bob’s. Also, the pronoun should agree with the antecedent in number, gender, and case.

Use nominative pronouns as a subject (*I you he she it we they who*); objective pronouns as the object of a verb or a preposition (*me you him her it us them whom*); and possessive pronouns to indicate possession (*my your his her its ours yours theirs*).

Another important issue with pronouns is the lack of gender-neutral pronouns. Usually, it is customary to say *he or she*, to indicate gender-neutrality. Another solution, which is technically not grammatically correct, is to use the third-person plural, *they*.