The

Elements

of

Mathematical

Style

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Acknowledgments

The need for a guide like this became apparent during the 2010 GRCC Summer Assessment Institute, led by Marcie Sims and Kirsten Higgins of the English Division. My thanks to Marcie, Kirsten, and my fellow participants for helping me to sow the necessary seeds.

Obviously I've stolen Strunk and White's title. (Thanks, guys.) I have not made any attempt to mimic any of their work. While I have used their book in the past, it was many years ago, and at this writing I do not even own a copy, an unfortunate state of affairs which I should remedy with all deliberate speed.

Much of the original draft of Chapter 1 was written on a napkin while under the influence of a Devil's Trap Latte and a Serenity Ploughman during a Tonia Opland show at the Wayward Coffeehouse in Greenwood. Errors nevertheless remain the responsibility of the author. Y'all rock.

Great thanks and professional admiration to the good people at the GRCC Print Shop for their unwavering commitment to excellence, speed, and good cheer.

Use

To The Student

This guide's purpose is to help you to present your mathematical work in the best possible light. Orderly work that follows standard conventions is easier to write, easier to read, easier to study from, and less prone to careless errors, all of which contribute to making you more successful in your mathematics classes. While there are many commonalities, each discipline has its own set of standards for written work; this guide aims to help you with those of mathematics. Use the entire guide; something that's listed under "Essays and Projects" might still be very helpful in your notes, for example.

This guide is intended for use at the community college level on campuses where Microsoft Word is the dominant word-processing software. Word, however, is not the standard program for writing in professional mathematics; as you move into 300- and 400-level courses, and perhaps even in some of your higher-level community college courses, you will be introduced to others that are better suited to that material.

(So why use Word here? Simply put, it's what we have in the campus computer labs, and it's more than good enough for what we need.)

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to clean up the bottom of the page (where Word will want to insert an actual footnote). The caret symbol, ^, can be used for exponents ("x^2" for "x^2"), but it's a poor substitute.

Citing Sources

If your essay or project (or any other activity) contains anything other than your own work, cite your sources. Not doing so constitutes academic dishonesty and can bring a wide range of serious consequences. If your instructor prefers a certain format (e.g., MLA or APA) for your citations, follow it; there's probably a reason. Otherwise, the format isn't all that important, as long as the documentation of the source is clear.

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CHAPTER 0
IN CLASS

NOTES

Take Notes!

Always take notes in class. Even if it's something you already completely understand, write it down, for three reasons, any one of which would be good enough on its own. First, you may find out that you don't understand it quite as well as you thought you did, and if you're halfway through the lesson when that happens, it can be awfully hard to go back and fill in the gaps while you're trying to keep up with something you don't fully understand. Second, what makes sense now may not make sense an hour, or a day, or a week, or a month from now, and it'll be very nice to have notes to help you then. Third, good notes on things you understand can help you see the logical development of things that don't make as much sense to you, and those strange ideas can start to seem less strange.

Pencil vs. Pen

Anyone who tells you that you must take notes in pencil OR that you must take notes in pen is, in no uncertain terms, simply wrong.[1] Pencil has the advantage of being easy to erase, and that's important in note-taking. But pen has the advantage of durability; pencil smudges over time and can be difficult to read a week or a month later when you're studying for a test or a final exam, and that's just as important. You need to decide for yourself what does the best job of meeting your needs. Consider using colors and/or highlighters on important points, too.

[1] If one of these people happens to be your instructor, and if your notes will be part of your grade, that's unfortunate, but do it the way your instructor wants. Some battles are worth fighting. This isn't one of them. That applies to any work you turn in, too, as well as quizzes and tests.

attention when you're typing several lines of mathematics, because Word will normally interpret each one as a new sentence and capitalize the first letter. That, too, will need to be undone.

Graphs

In addition to being able to import graphs and tables from Excel to your Word document, you can download graphs, tables, and other screenshots from TI graphing calculators into Word. See your calculator's guide book or talk to your instructor to learn how.

Even if you're typing your mathematical notation, you may want to draw graphs by hand. That's acceptable. Make sure, as always, that your graphs are properly labeled, properly scaled, and correctly drawn. Put them in suitable places in your work, too. Don't separate them from the work to which they pertain.

The Equation Editor

To use the equation editor in Word 2007 (see your instructor for help with earlier versions), click on the "Insert" tab and look to the right-hand side of the screen. You'll see two options, one for a "Symbol" and one for an "Equation." (Note here that "Equation" covers a multitude of things, many of which are not actually equations.) If you only need to insert one or two mathematical symbols, and if they're relatively common ones, you may find them under the "Symbol" option, and if so, that's probably easier. For anything more complicated, choose the "Equation" option and select a template that fits what you're trying to type. (You'll also see that a few common objects, such as the quadratic formula, are prefabricated and may be taken directly.) You can click through the parts of the template or use the arrows to move through them. When you've filled out the template, simply click somewhere outside the equation box. The equation box in then embedded in

(e.g., you should write "5 + 3 = 8" rather than "five plus three equals eight").

Likewise, symbols should be used as symbols, not words (e.g., write "f'(x)" rather than "f prime of x"). An exception would be if the purpose of your writing were to explain something about the symbol itself. In that case, you might write something like "the integral sign," although even then it would usually still be acceptable to write "the ∫ sign."

You should not, however, use symbols in cases where the symbol would be an inappropriate abbreviation. For example, you would ask, "What percent was the discount?" rather than "What % was the discount?" The % symbol is for use only with numbers. ("There was a 5 percent discount" and "There was a 5% discount" are both appropriate. Note that neither requires writing the word "five," and there would be no benefit to doing so in either case.)

Autocorrections

As discussed in Chapter 0, you should use horizontal fraction bars rather than diagonal ones. This remains true when typing, and you should also notice that Microsoft Word will autocorrect (by shrinking) some common fractions when a diagonal fraction bar is used; 1/2, for example, is autocorrected as ½. You'd need to undo these autocorrections to make all of your typed fractions look the same, which they should. Using the equation editor to make a horizontal fraction bar, like $\frac{1}{2}$, bypasses the autocorrection.

Another autocorrection to notice is capitalization. The letter i will be automatically capitalized whenever it stands alone. You will need to undo that capitalization, especially when imaginary numbers are involved. (Again, autocorrection does not happen in the equation editor.) The first letter of a sentence is also autocorrected to a capital, and that will happen if that letter happens to be something you're using as a variable. This requires particular

Shorthand

One of the biggest note-taking challenges for many students is keeping up with the speed of the discussion or lecture. Remember that you're taking NOTES. You're not transcribing the lecture verbatim. Don't write a whole sentence when a few words will suffice. Don't write a whole word when a couple of letters will do. If you know standard shorthand, by all means you can use it, but anything will do. You're the only person who has to be able to read your notes. As long as you know what the abbreviations mean, that's good enough, and that's easiest to achieve if you develop things that you use consistently.

Format

Your notes will be most useful to you if they are well-organized. Make sure that definitions, theorems, and other critical ideas stand out and are easy to identify when you come back to look at your notes. When these are written out in full on the board, they're well worth writing down word-for-word in your notes. Abbreviating the words is usually fine, but this is one time when you want to be sure you have all the right words in the right order, since even small changes can make a big difference in meaning.

Examples in your notes should be written in a way that is easy to follow and highlights the key concept(s) being illustrated. The example has a purpose, or more than one. You should be able to tell easily from your notes what that purpose is and where the example deals with it.

When examples are done on the board (or by PowerPoint, calculator projection, document camera, etc.), it's a good idea to write it down as completely as possible. Your instructor is presenting the example in a particular way to help you understand the ideas better, and you should take advantage of that in your notes. Annotating the example can also be helpful. Adding a few words next to it to explain what was

done or why it was done can make a big difference when you're using your notes later.

Keep things as neat as possible. Each line should be clearly distinct from the line before and the line after. You should be able to see the progression of ideas through an explanation, discussion, example, or the like. If you can line related parts up with each other, or show how they connect in some other way, your studying can be that much easier.

Fractions (and this applies in any situation, not just your notes) should be written with a horizontal bar rather than a diagonal one (e.g., $\frac{5}{8y}$ rather than 5/8y) to avoid any possible confusion over where the denominator ends. 5/8y can be interpreted as $\frac{5}{8y}$ or $\frac{5}{8}y$. Using a horizontal bar reduces that potential confusion immensely.

Recopying

It can be difficult to take high-quality notes "on the fly" in class. You should at least consider recopying your notes after class to improve organization, neatness, or other aspects of the presentation. Of course, that can take time and work, and you may find that the result isn't a big enough improvement to justify the effort. Only you can judge that for yourself. But you should consider it.

Worksheets, etc.

From time to time you'll have activities to do entirely in class and hand in.[2] Standards for this work aren't the same as for work done partly or entirely outside of class, but it does require more than your

[2] You'll also have activities done entirely in class that are not handed in. Those situations aren't quite the same as taking notes, but the purpose is the same, and the same standards apply.

Grammar, Mechanics, Spelling, Etc.

Correct grammar does not diminish in importance from one field to another. College students are expected to use correct grammar in their essays in all classes.

Writing Mathematics

In many cases, it is acceptable to type your essay but handwrite the mathematics in it. Typing is preferable, but not always practical. Leave an appropriate amount of space in which to write your work. Make sure you allow enough space, but not too much.

Typing Mathematics

Microsoft Word has an equation editor that allows you to type mathematical symbols and expressions. The version in Word 2007 offers some improvements over earlier versions in terms of presentation and significant improvements in ease of use.

Numbers and Other Common Symbols

Symbols, numerals, and other pieces of mathematical notation are part of the language of mathematics. They are used routinely in writing mathematics, just as discipline-specific technical components appear in the standard writing in any field.

There are certain common writing conventions which require some adjustment for mathematical work. For example, in many fields it is standard to express certain numbers in words (e.g., writing "five" rather than "5"). That is generally not a requirement in mathematical writing, and it should be specifically avoided when the numbers are part of a calculation

CHAPTER 3
ESSAYS AND PROJECTS

Being able to communicate your thoughts and ideas in writing is important in every discipline, and mathematics is no exception. That's why Written Communication is one of the campus-wide learning outcomes.

Typing

Type!

College students type their essays. There are no exceptions.

Font

Use a standard font. Your instructor may have requirements; if so, they exist for reasons, some of which may be related to how specific symbols you'll be typing appear in different fonts. Follow those requirements, if there are any. If not, choose a standard font in a standard size. The text in this guide is in 9.5-point Century Gothic. Century Gothic uses about 30% less ink than Calibri (the default font in Microsoft Word 2007). Unfortunately, the same point font in Century Gothic is larger than in many other fonts, so it uses more paper. Century Gothic in 9.5-point is about the same size as 12-point Times New Roman.

Color

Color printer ink is expensive. Use it only if you have a truly compelling reason.

Page Layout

If your instructor has requirements for margins, paper size, and the like, follow them. Otherwise, use standard settings.

notes do, because you're communicating your ideas to people other than just yourself.

Self-Contained Worksheets

Some of the activities will be worksheets that provide space for you to show your work. In almost every case, the space provided should be enough for even people with large handwriting to show their work completely. Use that space. Once in a while it may be necessary to continue a solution on the back of the page or on another paper, but usually you shouldn't need to.

You may want to do your work separately and then copy it neatly to the worksheet page. That's admirable, but it's often not practical on an in-class activity. You have limited time to complete the activity, and very often that simply does not allow for rewriting solutions.

As you write your solutions, make each step visually distinct from the others. Graphs should be properly labeled and scaled. When you make mistakes (and everyone makes them sometimes on activities like these), erase them completely or, if you're working in pen, cross them out neatly and completely.

You should show enough work so that the reader can easily follow what you've done throughout your solution. It should be readily apparent to your reader how you went from one step to another.[3] Line related parts up from one line to the next. For example, if several lines all include an "=" sign, try to have it in the same place in each line. The logical progression of ideas in your solution should be

[3] A reasonable question here is to ask who the reader is. Obviously people at different mathematical levels would require different levels of explanation to follow your work. Assume that the reader is someone like you, or that you are the reader. Ask yourself whether you would be able to understand what this person had done, if someone else had done the work and given it to you, and if you had not already worked it out yourself.

apparent in the visual presentation of your solution, too.

On Your Own Paper

At other times, you'll be asked to use your own paper for activities done in class and handed in. In principle, the same standards for homework apply to this, but as a practical matter, the time constraint often doesn't allow for quite the same presentation. Still, there are some useful guidelines.

Unless specifically directed otherwise, use fresh paper. Don't use a page that has notes (you wouldn't want to separate one page of your notes from the rest anyway), scribbles, doodles, scratch work, or anything else written on it. Dedicate a new page to this specific activity. Besides making a better presentation to others, you'll also create work that will be more help in your own studying later.

Present the problems or parts of the activity in the order in which they were posed to you, unless you have a very good reason for changing it, and in the highly unlikely event that you do change it, make sure it is abundantly clear (1) that you changed it and (2) why you changed it. It isn't necessary to do the problems in that order; if you do skip one, leave enough space to come back and do it later. Of course, you'll be guessing at how much space you'll need, and sometimes you won't allow enough. When that happens, don't try to squeeze all your work into a space that's too small. Simply write normally, make a note so that the reader knows that it continues later (at the end of the assignment, if possible), and also make a note at the point where it continues to make it clear that you're finishing that problem at that point.

The same standards as for self-contained worksheets apply to this sort of activity as well in terms of showing each step clearly, labeling and scaling graphs appropriately, correcting mistakes, presenting your work, and so forth.

Fixing Errors

You'll make mistakes on tests and quizzes. Everyone does. The only questions are when and how many. To correct your mistakes, erase them completely if possible, or cross them out decisively, making sure it is completely clear what is crossed out and what isn't. (Most people take tests and quizzes in pencil. Unless your instructor tells you differently, it is okay to use pen, but only if you can do so neatly, including correcting errors.)

Organization

As always, present your work in an orderly way. Your instructor should be able to follow your solutions from beginning to end easily. Keep related parts of your work together; try to line up things like "=" signs from one line to the next.

Circle your final answers. Make the end obvious in some other way if circling is impractical. Knowing when you've completed a solution is as important as any step in the process. If your instructor can't tell whether you know when you're done, it's perfectly reasonable to assume that you don't.

Terminology and Notation

Correct usage of mathematical language and symbols is every bit as important under the time pressure of a quiz or test as it is in homework or anywhere else, and arguably more so, because it's part of what's being tested. You should expect to lose points if you use a word or symbol incorrectly or inappropriately.

CHAPTER 2
QUIZZES AND TESTS

While most of the same expectations for other activities apply to quizzes and tests as well, there are aspects of quizzes and tests that are enough different to deserve some separate attention. (This chapter does not apply to take-home tests and things of a similar nature, which should be treated as homework for these purposes. Presumably you'd want to treat them as very special, very important homework.)

Time Issues

Time, in short, should not be an issue on quizzes and tests. Your instructor is a trained professional who takes care to craft a test that allows ample time for adequately prepared students to complete it successfully. So while there is a time limit, your presentation of your work should not suffer significantly from time pressures.

Space Issues

As with time, space to show your work should not be a factor affecting your presentation. Your instructor knows how much space a solution to each problem should require and provides space accordingly, even for people with large handwriting. If you need more space, make it clear that you're continuing your solution elsewhere. Make it clear where the reader should look for the continuation, and in that additional space, make it clear which problem you are continuing. If you need additional paper, either for continuations or for scratch work, ask your instructor. In most cases, you'll probably be told to go ahead and use your own paper, but ask first. Otherwise it can look like you're cheating. You don't want to look like you're cheating.

In Groups

Sometimes you'll be asked to work with one or more other students on an in-class activity. These same standards apply to that situation. The only thing that might be different would be if the group were asked to turn in only a single set of solutions. In that case, designate one person as the group's scribe. Everyone else in the group should write down his or her own copy of the work for later studying purposes, and someone in the group should make sure that the scribe (whose paper will be turned in) gets one too.

On the Board

At times, you'll be called upon to present your work to the rest of the class on the board (or perhaps in some other way, such as using a document camera).

When You're at the Board

Writing on a vertical surface like a whiteboard or chalkboard isn't as easy as it might sometimes appear to be. Remember that your instructor is a trained professional and you, in most cases, are not. Nobody expects your writing on the board to look the same as that of somebody who has made a career of it. Use a marker that shows up well (and if you pick up a dead one, toss it out rather than leaving it for someone else to try to use). Try to keep your writing neat and orderly. Don't show unnecessary detail, but don't leave important parts to the class's imagination, either.

If you're asked to explain your work to the class, which you often will be, speak loudly enough to be heard throughout the room. Use correct terminology. Your oral explanations can certainly enhance your written work. If you discover an error in your written work while you're explaining it orally, by all

means call attention to it and fix it if possible, or ask for suggestions if you need them.

Unless there's an error or something else significant that happens (such as an alternate solution), you probably don't need to worry about taking notes on your own boardwork. Most people remember that just fine.

And don't worry about what others think. They should be supportive and encouraging at all times.

When Others are at the Board

Take notes on other students' boardwork just as you would take any other notes. The exception would be if it's a problem you've done too, such as a homework problem, but in that case you should still pay attention and makes notes (and corrections, if necessary) if and when the presented solution is different from yours.

Be nice! Of course you should ask questions when you don't understand something or if there seems to be an error, but it is flatly unacceptable to criticize or make fun of another student or his or her written or oral work.

But even those don't care won't mind if it's not there, so get rid of it.

NEVER ask an instructor for a stapler. It's like saying, "I threw this together at such the last minute that I didn't even have time to staple it," which definitely isn't the message you want to send.[5]

[5] A small stapler and a box of 5,000 staples can be had for under $5 and should be part of every college student's arsenal.

to others, you'll also create work that will be more help in your own studying later.

Present the problems or parts of the activity in the order in which they were posed to you, unless you have a very good reason for changing it, and in the highly unlikely event that you do change it, make sure it is abundantly clear (1) that you changed it and (2) why you changed it. It isn't necessary to do the problems in that order; if you do skip one, leave enough space to come back and do it later. Of course, you'll be guessing at how much space you'll need, and sometimes you won't allow enough. When that happens, don't try to squeeze all your work into a space that's too small. Simply write normally, make a note so that the reader knows that it continues later (at the end of the assignment, if possible), and also make a note at the point where it continues to make it clear that you're finishing that problem at that point.

Terminology and Notation

Use mathematical language correctly. Do not, for example, say "solve" when you should say "simplify" (or vice versa). Know the meanings of the words you're using. More importantly, know why you're using them and what they mean in that context, so that this won't be a problem. If you're not sure of the right word, look it up. It'll take no more than a few minutes, and you'll live happily ever after.

Use mathematical notation correctly, too. Don't, especially, say that two things are equal (by using the "=" sign) unless they are, in fact, equal. Again, if you're not sure, look it up, or ask.

Presentation

When the assignment is due, come to class (on time, of course) needing to do nothing but hand it to your grateful instructor. Some instructors care about the "fuzz" left by spiral-bound notebooks; some don't.

CHAPTER 1
AT HOME

This chapter covers any handwritten work that is to be handed in and that is done partly or entirely outside of class. Because there is not a significant time limit, there is a higher standard for presentation than there is for work done entirely in class, where there are fewer opportunities to pay full attention to issues of presentation.

Structure

If you're doing a worksheet or other activity where you are given a page on which to show your work, use it. First, though, at least sketch a draft of your solutions elsewhere, possibly even doing the work in full, and then transcribe it to the page to be turned in. Attach additional pages if and only if it is absolutely necessary to do so, and if you do, make sure it is absolutely clear where each problem continues.

If you're using your own paper, depending on the horizontal space the problems require, either go directly down the page from one problem to the next, or use two columns, but only if none of the problems run beyond their column of origin.

Do not, unless specifically directed to do so, put your answers in a column by themselves or otherwise separate them from your work. While it's nice to have correct answers (other things being equal), it's just not that important in the whole scheme of things. The work that produces the answers, whether the answers are right or not, is of far more interest.

Do, however, clearly identify your answers, preferably by circling them, or, where answers in complete sentences are called for, by writing them clearly and identifiably. The ends of proofs are

traditionally marked with Q.E.D.[4] or the symbol ■. This isn't so much about the answer as it is about showing that you know when you've solved the problem, which is just as important as the other components of problem-solving.

Organization and Appearance

Much of this is the same as for in-class work, but there is much less margin for forgiveness when you're not working under in-class time pressure. Write your solutions in a way that is friendly to the eye. Your writing should be legible, and common confusions, such as those listed on the next page, should be addressed with particular care.

As you write your solutions, make each step visually distinct from the others. Graphs should be properly labeled and scaled. When you make mistakes (and everyone makes them sometimes), erase them completely or, if you're working in pen, cross them out neatly and completely.

You should show enough work so that the reader can easily follow what you've done throughout your solution. It should be readily apparent to your reader how you went from one step to another. Line related parts up from one line to the next. For example, if several lines all include an "=" sign, try to have it in the same place in each line. The logical progression of ideas in your solution should be apparent in the visual presentation of your solution, too.

Unless specifically directed otherwise, use fresh paper. Don't use a page that has notes (you wouldn't want to separate one page of your notes from the rest anyway), scribbles, doodles, scratch work, or anything else written on it. Dedicate a new page to this specific activity. Besides making a better presentation

[4] Q.E.D. is an abbreviation for the Latin "Quod Erat Demonstrandum," which means "that which was to be shown." (W^5 may be used if you're feeling daring. It stands for "Which Was What We Wanted.")

Common Symbols that Require Care	How to Avoid Confusion
5 and S or s	Write the letter S or s in cursive.
t and +	Write the letter t with a tail.
u and v	Write the letter u with a tail and the letter v with a clear point.
1, l, and 7	Write the lower-case letter l in cursive. Cross the numeral 7.
m and n	Be consistent; in cases where both m and n appear, either print both or write both in cursive.
2 and z	Cross the letter z.
6 and b	Make the back of the numeral 6 clearly curved and the back of the letter b clearly vertical.
∫ and S	The integral sign ∫ should be clearly elongated.
0, o, O, ∅, and σ	The Greek letter σ should have a clear tail. Try to avoid using the letter O (or o). Never put a slash through the numeral 0.
i and j	The letter j should have a clear tail.
9 and g	The letter g should have a clear tail.
∑ and E	The Greek letter ∑ should have sharp corners and no vertical segments. The left side of the letter E should be vertical.