Here are some observations about the writing of mathematics that I ho e wi be usefu as ou wor on the writing assignment for this course

G a s an a ience s with an written iece mathematica e osition must be written with a articu ar au ience an s eci c goa s in min e sure ou have a c ear sense of what these are before ou start writing

he r cess It is im ortant to bear in min that writing is a *process* ust i e roving a theorem one ours forth a we organi e c ear an error free e osition the rst time the sit own to write ust as no one ro uces a com ete we structure roof the rst time the thin about a rob em ost goo e ositor rose has been thorough rewritten at east once or twice before it reaches the rea er with e sections un ergoing erha s three to ve ma or revisions o some eo e this thought ma es the ros ect of writing seem aunting or even overwhe ming but it nee n t he i ea that much of what ou write wi eventua be re ace or iscar e can be iberating Just sit own an write nowing that an thing that oesn t measure u can ater be e might we n ourse f throwing awa the rst severa ages ou write this is not waste time since the tria an error rocess he s ou immense in c arif ing what ou rea want to sa

hen ou begin writing a raft the intro uction ma not be the best ace to start since the structure of the a er ma not become com ete c ear unti ater in the rocess r starting somewhere in the mi e with whichever art of the a er is c earest in our min s soon as ou have a section or more in re ative coherent form sit bac an rea it ut ourse f in the min of our au ience an see if it ma es com ete sense hen rewrite

hen ou have something ou thin is c ose to acce tab e give it to someone e se to rea an comment on hen rewrite again

fter ou thin the a er is nishe go through it with a ne toothe comb an a shar ra or har en our e nitions statements of theorems an roofs arif our ogic an our intuitive escri tions a e sure our s e ing unctuation an grammar are abso ute correct mit nee ess wor s termino og an s mbo s

Note that rewriting usua means much more than sim correcting errors It means oo ing critica at what ou ve written both oca an g oba guring out what wor s we an what oesn t an oing whatever is necessar to ma e the who e thing wor erfect

n enti ns though ou might not be ieve it after rea ing some of the mathematica writing that has ma e it into rint mathematica writing shou fo ow the same conven tions of grammar usage unctuation an s e ing as an other writing his means in articu ar that ou must write com ete sentences organi e into aragra hs hi e man mathematica terms have technica meanings that are i erent from their usage in or inar ng ish ou shou sti be carefu to observe the usua ru es regar ing arts of s eech an sub ect verb agreement though ou wi run across a too man mathematicians who

recisi n. In mathematica writing more than an other in recision is of aramount

correct ⁻ use he sentence ˛ et f be the function whose va ue at a articu ar number is e ua to the s uare of that number a e to the number itse f is far ess c ear than ˛ et f be the function e ne b⁻ $f⁻x \mid x^2$ x n the other han e cessive use of s⁻mbo s can ea to writing that is ust as obscure

Here are some gui e ines for using mathematica s⁻mbo s in ⁻our writing

- ee the number of name s⁻mbo s to the minimum necessar⁻ for c arit⁻ I ea ⁻ each s⁻mbo shou refer to an ob ect whose ro e in the a er or in a articu ar section of the a er is im ortant enough that ⁻ou want the rea er to remember it b⁻ name his is es ecia ⁻ true in statements of theorems hich of the fo owing statements is c earer

  ⁻**he re** *If G is any Lie group, there exists a Lie group $\widetilde{G}$ that is the universal covering group of G.*

  ⁻**he re** ′ *Every Lie group has a universal covering group.*

  f course even if ⁻ou use the secon version in the roof of the theorem ⁻ou wi robab ⁻ want to intro uce s⁻mbo s such as G an $\widetilde{G}$ to refer to the given grou an its universa cover
- ing e s⁻mbo s an short sim e formu as shou be inc u e right in ⁻our ara gra hs but a formu a that is arge or es ecia ⁻ im ortant shou be centere on a ine b⁻ itse f ⁻this is ca e a is a⁻e formu a
- ver⁻ mathematica s⁻mbo or formu a whether inc u e in the te t or is a⁻e must have a e nite grammatica function in a sentence usua ⁻ as a noun or a c ause onsi er the fo owing sentence

  If $x >$ we see that $x^2 \quad x$ must be greater than

  Here the formu a $x >$ is a c ause whose verb is $>$ whi e $x^2 \quad x$ functions as a noun
- If a is a⁻e formu a en s a sentence it must be fo owe b⁻ a erio
- he best wa⁻ to ensure that ⁻our formu as function grammatica ⁻ correct ⁻ is to rea each sentence a ou hen ⁻ou o so bear in min that man⁻ s⁻mbo s can be rea in severa i erent wa⁻s for e am e the s⁻mbo can be rea as e ua s e ua to be e ua to or is e ua to e en ing on conte t
- ⁻mbo s re resenting mathematica re ations ⁻i e $>$ or $\in$ or o erators ⁻i e $-$ or $\cap$ shou be use on ⁻ to connect other mathematica s⁻mbo s not wor s or e am e o *not* write

  ˛ et v be a vector of ength $<$ that is $\in T_xM$

  Instea this sentence cou be rewritten as fo ows

  ˛ et $v \in T_xM$ be a vector such that $|v| <$
- ractions an fractiona e ressions inc u e in the te t shou be written with a s ash as in $x/⁻y$ If a fraction is so arge or com icate that it nee s to be written using a hori onta bar it shou be is a⁻e he on ⁻ e ce tions are sma numerica fractions such as $\frac{1}{2}$ which can be inc u e in te t as ong as the⁻

- he s⌟mbo s of s⌟mbo ic ogic such as ∃ ∀ ∧ ∨ ¬ an ⇒ shou never be use in forma mathematica writing un ess ⌟ou are writing about s⌟mbo ic ogic an the⌟ a ear in ogica formu as therwise write out the wor s instea

itin s rces. hen ⌟ou write a mathematics a er ⌟ou must ist in ⌟our bib iogra h⌟ ever⌟ ub ishe source from which ⌟ou obtain i eas mathematica resu ts roofs facts or s eci c anguage henever ⌟ou write something that ⌟ou obtaine from such a source ⌟ou must refer s eci ca ⌟ to the source in the te t If ⌟ou use a arge amount of materia from one source as ⌟ou might o in an e ositor⌟ a er it s ermissib e to write something i e a of the resu ts in this section are from but it s not enough ust to ist a a er or boo in ⌟our bib iogra h⌟ Here are some e am es of situations that re uire citations

The bibliography The conventions for bibliographic references in mathematical writing are somewhat different from those in other fields. Some bibliography is shown below. The first entry is for a book, the second is for an unpublished preprint in an online database.

[1] J. R. Dieudonné, P. R. Halmos, M. M. Schi er, and N. E. Steenrod, *How to write mathematics*, American Mathematical Society, Providence, 1981. Look especially at the essay by Halmos, which is a classic.
[2] L. Gillman, *Writing Mathematics Well*, Mathematical Association of America, 1987.
[3] D. E. Knuth, T. Larrabee, and P. M. Roberts, *Mathematical Writing*, Mathematical Association of America, Washington, 1989. Look especially at pages 1-8.