SAN JOSÉ STATE UNIVERSITY DEPARTMENT OF MATHEMATICS AND STATISTICS LATEX THESIS TEMPLATE

A Thesis

Presented to

The Faculty of the Department of Mathematics & Statistics

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

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May 2024

The Designated Thesis Committee Approves the Thesis Titled

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APPROVED FOR THE DEPARTMENT OF MATHEMATICS & STATISTICS

SAN JOSÉ STATE UNIVERSITY

May 2024

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ABSTRACT

SAN JOSÉ STATE UNIVERSITY DEPARTMENT OF MATHEMATICS AND STATISTICS LATEX THESIS TEMPLATE

by Edgar A. Bering IV

A LaTeX template for SJSU Theses in the mathematics department, conforming to the SJSU 14 Rules for Formatting and the American Mathematical Society journal article style. Prepared for the ease of SJSU students in preparing their theses.

DEDICATION

A dedication is optional.

ACKNOWLEDGMENTS

I would like to thank my colleagues for sharing their past LaTeX thesis templates and their feedback during the departmental guidelines approval process. I would also like to thank Cheryl Cowan for assistance in ensuring this template conforms to SJSU thesis guidelines.

Acknowledgements are optional.

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1. Introduction

The existence or non-existence of a LaTeX template for mathematics theses has waxed and waned over the years. Most recently, Computer Engineering developed a template implementing IEEE style [Ana18]. Unfortunately, the faculty member who developed that template left SJSU and subsequently it has become out of date relative to the current IEEE format. The IEEE template was implemented in a coding style that made it difficult to transition between a thesis and a journal article, as well as susceptible to drifting out of date. This template is implemented in a more canonical LaTeX style. It is easy to convert between this LaTeX package and standard journal packages. This class is also designed to automatically incorporate updates to the American Mathematical Society journal styles on which it is based, provided the thesis author installs the up-to-date AMS style files.

1.1. Departmental approval history.

- Approved February 22, 2024 by Cheryl Cowan for the College of Graduate Studies
- Approved February 23, 2024 by the Graduate Curriculum Committee (5-0) for the Department of Mathematics & Statistics.

2. Departmental Formatting Guidelines

The primary formatting rules are the SJSU 14 rules for formatting and the SJSU Thesis Guidelines. In all cases where these defer to a disciplinary style, theses will follow the American Mathematical Society Journal Style Guide [LWS17], hereafter AMS style. The style guide is available online at

`https://www.ams.org/arc/styleguide/AMSstyleguide.pdf`

In AMS style certain choices are left to the author, or vary among AMS journals. The remainder of this section provides a brief overview of AMS style and specific choices for Mathematics & Statistics theses, for reference for our publishing partners.

2.1. LaTeX template is authoritative. The AMS publishes LaTeX class and style files implementing AMS style. This thesis template is based on them, and provides an example of appropriate heading formatting. If a thesis is prepared using this template and compiled with up-to-date versions of the `amscls` and `amsrefs` package then it is by definition formatted according to AMS style.

2.2. Headings and subheadings. The departmental thesis guidelines deviate from AMS style to comply with SJSU rules and for readability. Section headings are boldface, title case (Chicago Manual of Style definition), centered, on their own line, and unpunctuated. Subsections and subsubsections are boldface, sentence case, non-indented on the line beginning the appropriate division, and punctuated. All sectional numbering is boldface.

2.3. Figures and tables. AMS style requires table titles to appear above tables, and figure titles appearing below figures. This is identical to the SJSU Rule 10 default. The tables and figures below are to demonstrate the LaTeX table formatting. In an acutal thesis, these figures and tables would need to be referenced in the text prior to their apperance.

Table 1. Table captions appear above tables.

Symbol	Name
σ	Greek lowercase sigma
$\otimes$	Tensor product

Table 2. A second table, with a preposterously long caption. In the table of contents specifications, a table or figure must appear with either its title, or if that is too long, the first sentence or sentence fragment thereof. LaTeX will correctly handle captions of any length, but the author can specify their chosen fragment.

Symbol	Name
$\times_G$	G-twisted product
$\square$	End of proof symbol

Figure 1. Appropriate figure captioning.

2.4. References. Bibliographies should be formatted using the `alphabetic` option of AMS style, as shown in the sample below. The output of the `amsrefs` is the canonical implementation of AMS style bibliographies, and a bibliography generated with the current version is by definition correct. The References section should appear at the end of the main document. The remainder of this subsection documents and provides examples of AMS bibliographic format, summarized from the style guide and *Mathematics into Type* [LWS17, Swa79], the authoritative formatting guides for bibliographies in mathematics.

2.4.1. References to Mathematical Reviews. Any bibliographic entry indexed in the *MathSciNet* database (formerly *Mathematical Reviews*) may include a MR number at the end of the entry.

2.4.2. Preprints and websites. References to preprints and websites are formatted as follows. Author(s), title, and year are mandatory. If available an electronic identifier (DOI or arXiv number or url) is required.

[LN02] Preprint Author Last Name, *Title of preprint in itallic, case as in original* (2002), available at `arXiv:1202.1234`.

2.4.3. Journal articles. References to journal articles are formatted as follows. Author(s), title, journal name (in full or in standard abbreviated form), and year of publication are mandatory. All other data is optional and depends on the publication.

[LN42] Initials or full name Last Name, *Title of article in itallic, case as in original*, Journal name **Volume in bold** (1842), no. issue number, page numbers, DOI 10.nnn (Original Language if not English). MR31415

2.4.4. Books, monographs, and theses. References to books (and book-like things), including articles in collections, are formatted as follows. Author(s) or editor, title of book, title of conference (if applicable), title of paper (if applicable), series name (if applicable), publisher, year of publication, pages (if citing a chapter or paper) are mandatory. All other data is optional and depends on the publication.

[Aut50] Article Author, *Paper title in italic*, Conference proceedings title (Location, 1942), Publisher, 1950, pp. pages. MR1170366

[Aut52] Chapter Author, *Chapter title in italic*, Book title (Editor Name, ed.), Publisher, Location, 1952, pp. pages. MR1170367

[NA42] I. F. N. Name and Other Author, *Book Title in Italic, Case as in Original*, Series name, vol. Series volume, Publisher, 1842. MR2954043

[Aut17] Thesis Author, *Thesis title*, 2017. Thesis (Deg.Abbr.)–Granting institution. MR3781849

2.5. Mathematical enunciations and displayed equations. Mathematical writing contains a variety of special-formatted paragraphs, collectively known as *enunciations* in the AMS style guide. Enunciations **are not** subheadings and **do not** appear in the table of contents.

2.5.1. Forward references. Unlike tables and figures, all mathematical enunciations and displayed equations can be referenced before their first appearance in the text.

2.5.2. Display equations. Display equations are equations that appear on their own line, for example

$$a^2 + b^2 = c^2. \tag{2.1}$$

Note that mathematical formulae often ascend and descend significantly above and below line height, and are properly double spaced like so:

$$\begin{aligned} \int \frac{p(x)}{q(x)} dx &= \int b(x) + \frac{r(x)}{q(x)} dx \\ &= \int b(x) + \sum_{i=1}^{k} \frac{a_{ij}}{q_i(x)} dx \qquad (\star) \\ &= B(x) + \log(Q_{\mathbf{a}}(x)) \\ &= B(x) + O(\log(x)). \end{aligned}$$

Display equations cannot start a paragraph, but the text following a display equation can start a new paragraph, or continue the preceding one. Display equations are punctuated as if they appear within a sentence. Multiple equations can appear on successive lines, alignment between lines is dictated by disciplinary practice.

If a display equation is numbered numbered the number is set flush-left. Equations referred to outside of the paragraph where they appear must be numbered and referred to by reference.

2.5.3. Numbering of enunciations. Theorem, definition, and remark enunciations, as well as labeled equations, should be numbered sequentially with a common counter within sections. Proof enunciations are not numbered, and all proofs must end with an end of proof mark, such as □. The three exceptions to the numbering requirement are noted below.

Theorem enunciations appearing in the introduction may be numbered with a separate alphabetical numbering, provided that if the theorem is restated it uses the same number. The `sjsuthesis` class provides the `maintheorem` and `maincorollary` environments for this purpose.

Theorem enunciations with the heading "claim" may appear unnumbered within the body of a proof. The proof should be formatted using the `proofofclaim` environment.

Display equations that have a standard name, such as "Property (τ)" or "Condition (†)" may be labeled with the standard symbol instead of a number. Equation numbers always appear in parentheses, for example "Equation ($\star$)".

2.5.4. Appearance of enunciations. Theorem, definition, and remark enunciations may take any standard mathematical heading (for example "Lemma, Proposition, Corollary, and Claim" are all acceptable Theorem enunciations). Samples of proper enunciation formats appear below.

Definition 2.2. A natural number p is *prime* if whenever p divides a product ab then either p divides a or p divides b.

Theorem 2.3 (Euclid)**.** *There are infinitely many prime numbers.*

Proof. Consider a finite set $p_1, \ldots, p_n$ of prime numbers. Then one can check that

$$p_1 p_2 \cdots p_n + 1$$

is not divisible by any p_i. Therefore there is a prime number not contained in the set $p_1, \ldots, p_n$, from which it follows the set of all primes is infinite. □

Remark 2.4. This proof is often rendered as a proof by contradiction, but it is not.

3. User's Guide

3.1. Package options. The following options control certain aspects of the thesis:

- `single` Set single spacing, for **draft purposes only**.
- `3committee`, `4committee`, `5committee` to set the number of committee members (default is 3).
- `tables`, `figures` generate the list of tables and figures respectively. Each are mandatory if the thesis contains tables or figures.

3.2. Frontmatter. Frontmatter for the thesis (the abstract, dedication, etc.) should be configured as in the template file before the `\makefrontmatter` command. Setting the frontmatter is accomplished with a collection of commands and environments, with self-explanatory names, listed below:

- `\thesistype{thesis type}` use this command to use this template for MATH 298 writing projects.
- `\title{thesis title}`
- `\author{author}`
- `\dept{dept}`
- `\graduationmonth{month}`
- `\copyrightyear{year}`
- `\committee{name}{affiliation}`, use once per committee member
- The `abstract` environment
- The `dedication` environment
- The `acknowledgements` environment

3.3. Body. The body of the thesis is sectioned using standard LaTeX sectioning commands. Mathematical environments, such as theorems, proofs, etc. are provided for standard numbered enunciations:

- Theorem-style: `theorem`, `lemma`, `proposition`, `corollary`

- Definition-style: `definition`, `notation`, `convention`
- Remark-style: `remark`, `example`, `question`, `conjecture`

The unnumbered `claim` environment is provided for within-proof claims. A claim should be followed with a proof of the claim in a `proofofclaim` environment.

Additionally, the `maintheorem` and `maincorollary` environments are provided to introduce alphabetically-numbered theorems in the introduction and re-state them with the same number later. The usage is

- In the introduction use a `maintheorem` or `maincorollary` environment and `\label` it with a crossreference.
- Re-state the theorem or corollary with `\begin{repmaintheorem}{label name}` followed by the text of the statement.

New enunciations can be defined using the standard `amsthm` package commands. Use either `plain`, `definition`, or `remark` theorem styles as appropriate.

A new repeatable theorem, for the introduction, can be defined with

```
\newtheorem{mytheorem}[maintheorem]{Fancy Theorem}
\newreptheorem{mytheorem}{Fancy Theorem}
```

3.4. Equations and spacing. The full suite of equation, alignment, gather, etc. environments provided by `amsmath` is available, see that package's documentation. Equations often have a much higher line height than regular text, if that is the case, you will need to adjust the spacing for a particular tall equation to ensure appropriate doublespacing. That can be done with the following commands (see Equation ($\star$) in the style guide for an example)

- `\abovedisplayskip=12pt` set this before a display that *starts* with a tall formula
- `\belowdisplayskip=12pt` set this before a display that *ends* with a tall formula

- When breaking a line between formulas, at least one of which is tall use the end of line spacing command `\\[12pt]` instead of the default end of line.

3.5. Cross-references. This thesis template loads the `cleveref` package with correct options for thesis formatting. It is recommended that authors use `\cref` for all cross-references.

3.6. References. This class supports both `amsrefs`-style bibliography management, with appropriate formatting of both the `biblist` and `bibdiv` environments.

BibTeX is also supported. No `\bibliographystyle` command is required (and will be ignored if used). The `\bibliography` command will generate references from .bib files as usual.

Correct citations from the AMS citation database MathSciNet can be downloaded directly from MathSciNet in either `amsrefs` or BibTeX format.

References

[Ana18] David C. Anastasiau, *thesis_template-SJSU_CMPE* (2018), `https://github.com/davidanastasiu/thesis_template-SJSU_CMPE/tree/master`.

[LWS17] Mary Letourneau and Jennifer Wright Sharp, *AMS Style Guide*: *Journals*, American Mathematical Society, 2017.

[Swa79] Ellen Swanson, *Mathematics into type*, Revised edition, American Mathematical Society, Providence, RI, 1979. Copy editing and proofreading of mathematics for editorial assistants and authors. MR0553111

[Thu94] William P. Thurston, *On proof and progress in mathematics*, Bull. Amer. Math. Soc. (N.S.) **30** (1994), no. 2, 161–177, DOI 10.1090/S0273-0979-1994-00502-6. MR1249357

A. This is an Appendix

No this is Patrick. Appendices should still be double spaced so let's make sure of that post these bibliographic commands.