Standards for preparing theses and dissertations

Sixth Edition

2012

Mississippi State University
PREFACE

The thesis or dissertation is a formal research paper presented by a graduate student to the Graduate Faculty at Mississippi State University, who certify that the presented work meets the standards of the academic discipline. The Graduate School of Mississippi State University would like to extend to you, the student, a special welcome as you undertake the development and writing of your thesis or dissertation, an exciting and critical part of your academic achievement.

Developed by a committee of the Mississippi State University Graduate Council, this manual is an update of an earlier version of the Guidelines for the Preparation of Theses and Dissertations. While there has been no basic change in philosophy concerning the purpose and presentation of the thesis or dissertation, significant changes in the formatting requirements have been made due to the use of word processing technology in document preparation.

Personnel in the Graduate School and the Library’s Office of Thesis and Dissertation Format Review desire to make your research and writing a rewarding and enjoyable professional experience. The Graduate School is available to assist you in understanding the various policies and procedures necessary for completing your research project. For questions concerning format and appearance of your dissertation or thesis, contact the Library’s Office of Thesis and Dissertation Format Review.

Office of the Graduate School
E-Mail: grad@grad.msstate.edu
Web: http://www.msstate.edu/dept/grad
Telephone: 662-325-7400

Office of Thesis and Dissertation Format Review
E-Mail: etd@library.msstate.edu
Web: http://library.msstate.edu/etd
Telephone: 662-325-2170
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>ii</td>
</tr>
<tr>
<td>LIST OF SAMPLE PAGES</td>
<td>v</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. POLICY STATEMENT</td>
<td>2</td>
</tr>
<tr>
<td>III. LEGAL AND REGULATORY REQUIREMENTS</td>
<td>4</td>
</tr>
<tr>
<td>3.1 Previously Published Material</td>
<td>4</td>
</tr>
<tr>
<td>3.2 Copyrighted Material</td>
<td>4</td>
</tr>
<tr>
<td>3.3 Restricted Material</td>
<td>5</td>
</tr>
<tr>
<td>3.4 Microfilming the Graduate Degree Document</td>
<td>5</td>
</tr>
<tr>
<td>3.5 Research Protocols and Regulatory Compliance</td>
<td>5</td>
</tr>
<tr>
<td>IV. SUBMISSION OF THE THESIS OR DISSERTATION</td>
<td>6</td>
</tr>
<tr>
<td>4.1 First submission deadline</td>
<td>6</td>
</tr>
<tr>
<td>4.2 Submitting Electronic Theses and Dissertations (ETD) to the Library</td>
<td>7</td>
</tr>
<tr>
<td>4.3 Final submission deadline</td>
<td>9</td>
</tr>
<tr>
<td>V. FORMAT AND APPEARANCE</td>
<td>10</td>
</tr>
<tr>
<td>5.1 Thesis or Dissertation General Information</td>
<td>10</td>
</tr>
<tr>
<td>5.1.1 Page Size and Margin Requirements</td>
<td>10</td>
</tr>
<tr>
<td>5.1.2 Type Fonts and Print Quality</td>
<td>11</td>
</tr>
<tr>
<td>5.1.3 Line Spacing</td>
<td>12</td>
</tr>
<tr>
<td>5.1.4 Paragraph Requirements</td>
<td>12</td>
</tr>
<tr>
<td>5.1.5 Pagination</td>
<td>13</td>
</tr>
<tr>
<td>5.1.6 Footnotes, Endnotes, and Bibliographical Material</td>
<td>14</td>
</tr>
<tr>
<td>5.1.7 Excess Blank Space</td>
<td>14</td>
</tr>
<tr>
<td>5.1.8 Submission in PDF Format for Review</td>
<td>15</td>
</tr>
<tr>
<td>5.2 Preliminary Pages</td>
<td>15</td>
</tr>
<tr>
<td>5.2.1 Title Page</td>
<td>16</td>
</tr>
</tbody>
</table>
5.2.2 Copyright Page (Optional) .............................................................19
5.2.3 Approval Page ................................................................................21
5.2.4 Abstract .........................................................................................26
5.2.5 Dedication (Optional) .................................................................31
5.2.6 Acknowledgements (Optional) ....................................................33
5.2.7 Table of Contents .........................................................................35
5.2.8 List of Tables .................................................................................46
5.2.9 List of Figures ...............................................................................51
5.2.10 List of Symbols, Abbreviations, Special Nomenclature, and Other Preliminary Pages ..........................................................56

5.3 Main Body ...........................................................................................59

5.3.1 First Page of Each Chapter ............................................................59
5.3.2 Headings .........................................................................................62
5.3.3 Lists ...............................................................................................69
5.3.4 Block Quotes ..................................................................................69
5.3.5 Tables .............................................................................................70
5.3.6 Figures and Other Labeled Illustrations ........................................76
5.3.7 Landscape Pages ............................................................................82
5.3.8 Equations .......................................................................................85
5.3.9 Bibliographic Materials ...................................................................89

5.4 Appendices ...........................................................................................93

5.5 Supplemental Files ...............................................................................96

APPENDIX ........................................................................................................................97

A THESIS AND DISSERTATION SUBMISSION PROCESS ..........97

B AUTHOR CONTACT FORM .................................................................99

C ETD RIGHTS AND PERMISSIONS FORM ..................................102

D FORMATTING CHECKLIST ...............................................................106

E OTHER RESOURCES ........................................................................125

E.1 Workshops .......................................................................................126
E.2 Instructional Media Center ...............................................................126
E.3 Library Instructional Services Department ....................................126
E.4 The Writing Center ........................................................................126
### LIST OF SAMPLE PAGES

<table>
<thead>
<tr>
<th>Page Description</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Page</td>
<td>18</td>
</tr>
<tr>
<td>Copyright Page</td>
<td>20</td>
</tr>
<tr>
<td>Approval Page</td>
<td>24</td>
</tr>
<tr>
<td>Approval Page (Modified for Numerous Entries)</td>
<td>25</td>
</tr>
<tr>
<td>Abstract Page</td>
<td>29</td>
</tr>
<tr>
<td>Dedication Page</td>
<td>32</td>
</tr>
<tr>
<td>Acknowledgements Page</td>
<td>34</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>40</td>
</tr>
<tr>
<td>Table of Contents with Numbered Headings</td>
<td>43</td>
</tr>
<tr>
<td>List of Tables (Numbered Sequentially)</td>
<td>48</td>
</tr>
<tr>
<td>List of Tables (Numbered by Chapter)</td>
<td>49</td>
</tr>
<tr>
<td>List of Tables (Numbered by Chapter in a Document with Numbered Headings)</td>
<td>50</td>
</tr>
<tr>
<td>List of Figures (Numbered Sequentially)</td>
<td>53</td>
</tr>
<tr>
<td>List of Figures (Numbered by Chapter)</td>
<td>54</td>
</tr>
<tr>
<td>List of Figures (Numbered by Chapter in a Document with Numbered Headings)</td>
<td>55</td>
</tr>
<tr>
<td>Miscellaneous Preliminary Page</td>
<td>57</td>
</tr>
<tr>
<td>First Page of Chapter</td>
<td>61</td>
</tr>
<tr>
<td>Page with 1st and 2nd Level Headings</td>
<td>65</td>
</tr>
<tr>
<td>Page with 2nd and 3rd Level Headings</td>
<td>66</td>
</tr>
<tr>
<td>Page with 1st and 2nd Level Numbered Headings</td>
<td>67</td>
</tr>
</tbody>
</table>

v
Page with 2nd and 3rd Level Numbered Headings .............................................................68
Page with Table ................................................................................................................73
Page with Table and Text ..................................................................................................74
Page with Two Tables .......................................................................................................75
Page with Figure ................................................................................................................79
Page with Figure and Text .................................................................................................80
Page with Figures Side-by-Side .........................................................................................81
Page with Landscaped Table .............................................................................................83
Page with Landscaped Figure ...........................................................................................84
Page with Centered Equations .........................................................................................87
Page with Aligned Equations ............................................................................................88
Page for Bibliographic Material (end of chapter option) ...................................................91
Page for Bibliographic Material (end of document option) ...............................................92
Appendix Divider (Title) Page ..........................................................................................95
CHAPTER I
INTRODUCTION

Standards for Preparing Theses and Dissertations at Mississippi State University is intended to help graduate students organize and present the results of their research in the form of a scholarly document. This manual complements the current Graduate School Bulletin which provides uniform standards and contains general and program requirements for candidates pursuing advanced degrees as well as deadlines which candidates must meet. This updated Sixth edition (2012) replaces all previous guidelines.

All candidates for advanced degrees must confer with their advisors and graduate coordinators to learn specific departmental requirements for preparation and presentation of graduate degree documents. Students should remember that these documents are checked by personnel in the Library’s Office of Thesis and Dissertation Format Review to ensure conformity with this manual prior to final approval and publishing.
CHAPTER II
POLICY STATEMENT

Master’s theses, educational specialist’s theses, and doctoral dissertations are formal written documents resulting from careful and extended research conducted by graduate students under the supervision of their major professors and with the advice of graduate advisory committees. Both documents must demonstrate the ability of the candidate to pursue scholarly research at an advanced level; however, a doctoral dissertation must demonstrate more fully the candidate’s ability to plan and execute original research.

Writing and defending a thesis or dissertation is the culmination of a long period of sustained effort. The result should be a document in which the candidate, the advisor, the department, and the University can take pride. Theses and dissertations are representations of the standards of the degree-granting college and of Mississippi State University; these documents also reflect the standards of faculty members who sign the committee approval pages. Advisory committees are responsible for judging the technical and professional competency, writing quality, and professional appearance of these documents. All individuals involved in the preparation of theses and dissertations should ensure their work is of the highest quality possible.

The Graduate School and the Graduate Council understand that details and methods involved in thesis or dissertation preparation will vary among departments.
However, theses and dissertations must adhere to certain general standards and therefore must:

1. Be the result of concentrated effort to solve a well-defined problem. A graduate document must not consist of several studies related only in a general way but must focus on a coherent theme.

2. Furnish evidence that the candidate is familiar with the canons of scholarship in the discipline. Candidates must show familiarity with bibliographic literature and research methods and must present research results in a formal manner appropriate to the discipline.

3. Be readily comprehensible by other scholars in the field. Unless the candidate's program focuses on mastery of a foreign language, the graduate document must be written in Standard English.
3.1 Previously Published Material

Material previously published by the candidate while enrolled in the current degree program may be included in the document. Such material must be integrated into the body of the document, cited, and formatted to the guidelines listed in these standards.

3.2 Copyrighted Material

Mississippi State University sends all theses and dissertations to ProQuest Information and Learning to be microfilmed and made available to scholars. In compliance with ProQuest requirements, written permission of a copyright holder is required if substantial amounts of copyrighted materials are included. Requirements for gaining permission of a copyright holder are listed on the ProQuest website at http://www.umi.com/assets/downloads/products/UMI_CopyrightGuide.pdf. Failure to gain permission in advance of reproducing copyrighted material can delay the microfilming and may lead to charges of copyright infringement. Candidates are expected to read and abide by the copyright assurance and publication agreement in the ProQuest form they sign.

Copyrighting theses and dissertations is optional. Students desiring copyright protection should request the filing of copyright upon submitting their work to the publisher. Students should give serious consideration to copyright protection, and it is recommended that students seek advice from their major professor before making this
important decision. Copyright registration fees are charged to the student’s University account and must be paid before graduation.

Further information on Copyrights may be found at: http://www.copyright.gov/

3.3 Restricted Material

Thesis and dissertation documents should not include material restricted from publication by legal or proprietary considerations. Authors may request to restrict access or delay publication of their thesis/dissertation when completing the ETD Rights and Permissions form with their major professor’s signature. If the author’s major professor is completely unavailable to sign the form, then the author’s graduate coordinator’s, department head’s, or dean’s signature may be substituted.

3.4 Microfilming the Graduate Degree Document

For archival purposes, MSU requires microfilming of all theses and dissertations. Microfilming is part of the publisher submission process and is handled by the publisher.

3.5 Research Protocols and Regulatory Compliance

Students must secure prior approval of research protocols involving human subjects (including those protocols which utilize only surveys), animal subjects, radioactive substances, hazardous materials, recombinant DNA, or other regulated research. For more information see the Office of Regulatory Compliance website at http://www.orc.msstate.edu/. Questions about human subjects research should be directed to irb@research.msstate.edu. Questions regarding other types of research should be directed to compliance@research.msstate.edu.
CHAPTER IV

SUBMISSION OF THE THESIS OR DISSERTATION

The Graduate School establishes deadlines for the submission of documents to the Office of Thesis and Dissertation Format Review; these deadlines cannot generally be waived. The deadlines are posted in the Graduate Academic Calendar in the current issue of the *Graduate Studies Bulletin* and on the Graduate School’s website.

4.1 First submission deadline

To meet the first submission deadline, the student must:

- Complete all content corrections from the committee.
- Upload a single .pdf (of the completed document along with any needed supplemental files to the ETD server.
- Submit a hard-copy of the committee approval page with all signatures to the Office of Thesis and Dissertation Format Review. (A committee member may exercise their right to dissent and not sign. In such a case, a hard-copy of the committee approval page lacking only one signature will be accepted.)
  - Original signatures are optional. The signed approval page submitted to the Office of Thesis and Dissertation Format Review may be a photocopy/scan/facsimile, although an approval page with all original signatures is traditional should the author desire to include such in hard-bound copies of their work.
A “place holder” approval page may also be accepted that is lacking only one signature or if signatures are not yet compiled to a single approval page. This place-holder may be a photocopy, but must be replaced with a fully signed approval page before the final submission deadline.

- Submit completed Author Contact form and ETD Rights and Permissions form to the Office of Thesis and Dissertation Format Review.

### 4.2 Submitting Electronic Theses and Dissertations (ETD) to the Library

As of the 5th Edition (2007) of the Standards for Preparing Theses and Dissertations, documents must be submitted electronically; print documents are no longer published by the Library. Document submission must be in PDF (Portable Document Format) and uploaded through the ETD database. The Library’s Instructional Media Center (IMC) can assist in formatting Microsoft documents and converting them to .pdf files. Contact the Office of Thesis and Dissertation Format Review for instructions on including supplemental multimedia files.

Signatures should not be scanned for the .pdf document; for security reasons pages within the .pdf will remain absent of signatures. The Library will retain a copy of the committee approval page with the signatures for archival purposes.

To submit a .pdf to the Office of Thesis and Dissertation Format Review for format approval, the student will access the MSU Library ETD database and enter the requested information. Authors will be required to create a login on their first visit as this database is not linked with MSU’s NetID system.
1. Enter the authentication information and create an account (or log in if an account has already been created). Remember the account information; the Library staff cannot retrieve user IDs and/or passwords.

2. Complete the online forms using the spelling, punctuation, and capitalization that will create the desired appearance in the Electronic Thesis and Dissertation database.

3. Choose “Browse” to locate the needed file. (file name may not contain spaces or non-standard characters)

4. Choose “Upload Files” to copy the files onto the ETD server.

The ETD Rights and Permissions form and the Author Contact form must be submitted to the Library before the thesis or dissertation can be approved for format compliance. The forms are available in APPENDIX B, APPENDIX C, and on the Thesis and Dissertation webpage.

If there are formatting errors then a correction list will be sent to the student via email. The student must return to the original word processing document, correct errors, recreate the .pdf file, and resubmit via the ETD database. All drafts should be submitted with the intent that they are the final draft with all corrections made. If there is any confusion on the required corrections, please contact the Office of Thesis and Dissertation Format Review for clarification. An email will be sent to the student with instructions for submitting to UMI after all requirements have been satisfied and the thesis or dissertation has been accepted for format compliance.

Turnaround time for reviews will vary throughout the semester. Generally, two days will be the longest wait, however the week prior and the week of an initial deadline is high volume. During such times, it may be up to one week wait for a submission to be
reviewed. If a week passes with no correspondence, please contact the Office of Thesis and Dissertation Format Review to confirm the status of the submission. Submissions are reviewed in order that they are received, with first-time submissions having the highest priority. To help facilitate timely reviews, it is imperative that submissions after the first be accompanied by an email reply stating readiness for review.

4.3 Final submission deadline

The final submission deadline is the last day to obtain approval for format and subsequently submitting document to UMI. Any submissions that have not been approved by this deadline will be considered as submissions for the next review interval. After the submitting of the document to UMI, the Office of Thesis and Dissertation will review the final submission, make any necessary metadata corrections, and post any incurred fees to the author’s Banner account. All incurred fees must be paid prior to graduation.
5.1 Thesis or Dissertation General Information

Mississippi State University emphasizes the importance of conducting research to culminate in publication in the professional literature of the discipline. The thesis or dissertation may be written in a format acceptable to publication outlets in the candidate's discipline insofar as it does not conflict with the MSU’s Standards. If this format differs from the Standards in this manual then a letter from the major advisor, detailing the requested exception(s) to the standards, must be submitted to the Graduate School prior to the initial submission to the Library. If a formatting situation is not covered or forbidden by the Standards, please format consistently. Such situations should be discussed with the Office of TD Review prior.

The Graduate Council and the Library have developed precise standards to ensure that MSU theses and dissertations will have a consistently professional appearance. Close attention to these standards during document preparation will save time during the review process conducted by the Library’s Office of Thesis and Dissertation Format Review.

5.1.1 Page Size and Margin Requirements

All Theses and Dissertations should be on standard letter size pages (8.5” by 11”). Other page sizes are not permitted (such as A4, Legal, etc.).
The required margins are:

Top/Bottom: 1”
Left/Right: 1.25”

This will create 6” by 9” of printable space on the page and facilitates double-sided printing (if desired for hardcopies). No text or image should extend past the margins.

5.1.2 Type Fonts and Print Quality

- Font size must be twelve points. Any standard font that produces clean, crisp type with no distracting marks is acceptable. Decorative or difficult-to-read fonts (such as script or shadowed) are unacceptable. The Office of Thesis and Dissertation Format Review in the Library will make the final decision on the acceptability of the font used. Once selected, the type font must be consistent throughout the document. Exceptions for type and size may be made for:
  - Text inside tables and figures (not the titles) as well as notes for tables and figures may have any size text.
  - Superscripts and subscripts may use smaller text.
  - Equations may use any size text.
  - Footnotes and endnotes may use smaller text.

- Symbols used in paragraphs must be actual font characters (when possible), not images inserted in the line.

- Paragraphs may have text that is **bold**, *italicized*, **underlined**, in **dark colors** (on white background), or some combination of the previous. Any such text must be easily distinguishable from headings using similar formatting and must be consistently applied.
5.1.3 Line Spacing

Line-spacing terms used in this document are defined as follows:

This is what is meant by no blank lines:

There are no blank lines below this line.
There are no blank lines above this line.

This is what is meant by one blank line (commonly known as double-spacing):

There is one blank line below this line.
There is one blank line above this line.

This is what is meant by two blank lines:

There are two blank lines below this line.
There are two blank lines above this line.

This is what is meant by three blank lines:

There are three blank lines below this line.
There are three blank lines above this line.

5.1.4 Paragraph Requirements

All paragraphs in the document should have the following qualities:

- The left and indents of paragraphs must be 0”, i.e. the paragraph must align with the page margins. Lists and block quotes are exempt from this.
- The first lines of all paragraphs must be indented consistently; the indent must be either 0.25” or 0.5”.
• All paragraphs must be either left-aligned or fully justified, consistently. If a paragraph is fully justified, use line breaks to avoid awkward spaces in lines.

This is an example of a full justified paragraph. Do not leave a line in any justified paragraph like this.

• Paragraphs must be double-spaced (having only 1 blank line separating lines of text) and be separated from other paragraphs by 1 blank line. Excess space above or below a paragraph is not allowed unless otherwise stated in the Standards.

• Do not leave only one line of a paragraph at the top or bottom of a page (unless the paragraph only has one line). In Word, this can be avoided by turning on the “Widow/Orphan Control” setting.

• Symbols in paragraphs must be actual font characters (when possible), not images inserted in the line.

• Scientific names and other discipline-specific terms may be formatted as required by the department. For example, scientific names may be italicized.

5.1.5 Pagination

• Every page must have a page number except the title page, copyright page, approval page, and abstract pages.

• Small Roman numerals are used for the preliminary pages, which should be arranged in the following order: dedication; acknowledgements; table
of contents; and the lists of tables, figures, plates, symbols, abbreviations, and/or nomenclature. Although the title page is assigned Roman numeral i, that number does not appear on the page. Page numbers for other preliminary pages are centered, leaving 1 inch of white space from the page number to the bottom of the page. The copyright, approval, and abstract pages are neither counted nor numbered.

- Arabic numerals are used for paginating the remainder of the document, including the text and reference material. Pages are numbered consecutively beginning with 1 and continuing to the end of the document. No other numbering scheme is acceptable; the standard scheme may not be interrupted with insertions numbered 10a, 10b, 10c, etc.

All page numbers are placed at the bottom center position allowing 1 inch of white space from the numeral to the page bottom.

5.1.6 Footnotes, Endnotes, and Bibliographical Material

Footnotes and endnotes should be formatted to departmental standards. Candidates should confer with their advisors regarding citation styles acceptable to their disciplines and use the designated style manuals. Formatting for individual lines of the bibliographical material is also determined by the author’s departmental standards. However, the layout for bibliographic pages is discussed in section 5.3.9.

5.1.7 Excess Blank Space

In general, avoid any blank space not specifically required for the Standards. The following exceptions apply:
• Moving a table or figure to the beginning of a new page to avoid splitting is allowed.
• If excess space is caused by preventing a heading from sitting at the bottom of a page, it is allowed.
• If only three or fewer lines of a paragraph fit below a table or figure, it is allowed if the author begins that paragraph on a new page.
• Blank pages required by the department are allowed if a notification is added: “[This page left blank intentionally]”

5.1.8 Submission in PDF Format for Review

All submissions for review must be a single PDF file. This file should be created by conversion from the original word processing file used to create the document. Do not scan documents as PDFs as this may introduce margin inconsistencies and render the document’s text unselectable. Submitted PDFs should have the following qualities:

• Text must be selectable.
• Images should be actual image types and not objects (such as drawing tools, sigma plots, etc.). Objects increase files size and hinder viewing by increasing the load time for pages.
• All landscaped pages must be rotated into portrait pages.
• Fonts must be embedded to ensure cross platform fidelity of the text.
• The filename should not include any special characters or spaces.

5.2 Preliminary Pages

The preliminary pages must appear in the following order: title page; (optional) copyright page; approval page (without signatures); abstract;
optional) dedication; (optional) acknowledgements; table of contents; list of tables; list of figures; and list of symbols, abbreviations, nomenclature, or other such lists. Each element of the document is given in the order in which it should appear.

5.2.1 Title Page

A title page is required for all thesis and dissertation submissions. For consistency, the title page is designed from the “bottom up”, where the last line of text of the title page is on the last possible line of the page, exactly 1 inch from the bottom of the page. This is done to provide the maximum possible space for the possibility of long titles. The following list the requirements for the title page, starting from the bottom of the page and working up:

- No page number should appear on this page.
- All text on this page must be centered horizontally.
- Include Month and Year of Graduation (not defense; see academic calendar) with no commas (for example, “August 2011”) directly above the bottom margin.
- The location must be written as “Mississippi State, Mississippi”, leaving only one blank line between the location and the graduation date below.
- The degree statement must be single-spaced, accurate as of the graduate date, and worded exactly as follows (replace items in brackets):

  A [Thesis|Dissertation]  
  Submitted to the Faculty of  
  Mississippi State University  
  in Partial Fulfillment of the Requirements  
  for the Degree of [Degree–Ask Department]  
  in [Program or Concentration–Ask Department]  
  in the [Department/College Awarding Degree–Ask Department]
• Leave two or three blank lines between the degree statement and the location below.

• The author’s name must match that in MSU’s academic records.

• Leave 1.5 inches (eight blank lines is close enough) between the author’s name and the degree statement below.

• Leave one blank line between the word “By” (capitalized) and the author’s name below.

• Leave 1 inch (five blank lines is close enough) between the title and the word “By” below.

• If the title is more than one line, it must be double-spaced and each line of the title shorter than the line above it.

• The title must be not be in bold font. Capitalize only the first letter of the first word in the title and words normally capitalized in English (proper nouns, acronyms, etc.).

• The title must not have equations or symbols (type out symbol names and equations). Exceptions may be allowed at the discretion of the Office of TD Review.

See example on the following page:
The use of neural networks in the combining of time series forecasts with differential penalty costs

By

Morgan Beverly Wilder

A Dissertation
Submitted to the Faculty of Mississippi State University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Business Administration (Finance) in the Department of Finance and Economics

Mississippi State, Mississippi

December 1998
5.2.2 Copyright Page (Optional)

For documents to be copyrighted, notice of copyright is centered in the following form on the sheet immediately after the title page. The actual filing for copyright is the responsibility of the author. The publisher, UMI, will offer to file for copyright for a convenience fee, but the author is free to file independently. For more information about copyright, please see: http://www.copyright.gov/

Format the copyright page as follows:

- No page number should appear on this page.
- All text on this page is centered horizontally and vertically.
- The text must be double-spaced and must include the following:
  - Copyright notice, e.g., “Copyright by” or “©”
  - Author’s name, matching that on the title page.
  - Year of graduation

See example on the following page:
Copyright by

Morgan Beverly Wilder

1998
5.2.3 Approval Page

The committee approval page is the official form signifying the approval of the thesis/dissertation committee for the contents of the submitted document. All content-based corrections (not necessarily format) must be made prior to obtaining signatures. Any change in content as it relates to context or meaning after the submission of a fully signed approval page requires a newly signed approval page to allow for committee members to acknowledge the changes. This does not include such corrections as general formatting, typos, or spelling corrections. Typically, approval pages are signed after the defense if no revisions are requested. **Before obtaining signatures, a copy of the approval page should be submitted to the Office of Thesis and Dissertation Format Review to assess the format.** If the author is interested in pursuing the creation of hard bound copies of their work that included signed approval pages, then it is recommended that multiple approval pages be generated and signed individually. One copy of the fully signed approval page must be submitted and filed with the Office of Thesis and Dissertation format review before the submission will be accepted for review.

The approval page is formatted as follows:

- The title is placed just below the top margin. Format and wording of the title must exactly match the title on the title page.
- There must be 2 or 3 blank lines between the title and the word “By” below.
- The word “By” is centered on its own line, then followed by one blank line and the author’s name (centered and matching the name on the title page).
• The author’s name is followed by one blank line, then “Approved:” (left-aligned)

• Below “Approved:” are placed one centered column of signature lines.

• Lines are required for:
  o the thesis/dissertation director(s)
  o the committee members
  o the graduate coordinator (if not part of the graduate committee)
  o the dean of the college granting the degree

• Each signature line requires (the following must be single-spaced and left-aligned with the left edge of the signature line):
  o Enough space above the line for a signature
  o **First line:** The individual’s name without honorifics (like “Dr.”) or degree designations (like “Ph.D.”). This must match the name found on the Office of the Graduate School's [List of Graduate Faculty Members by Last Name](#)
  o **Second Line:** In parentheses, the role(s) of the individual, for example, “(Dissertation Director)” or “(Graduate Coordinator)” or “(Committee Member)”. If your graduate coordinator also serves on your committee, then add "/Graduate Coordinator" after the committee role.
    NOTE: The Dean’s title is his or her role; do not have anything in parentheses.

• Signature lines are ordered top to bottom. The first signature line must be the Thesis/Dissertation Director(s), followed by committee members, then the graduate coordinator, and finally the dean.
• All of this must fit on one page. There is no page number on this page.
  
  o If there is not enough space to fit all of the signature entries on one page in the center column, then the first two entries may be placed side by side, in a double column, with the required content centered within the column. This may be repeated as many times as necessary to minimally fit all the required entries on a single page.

  Note, if a committee member fulfills multiple roles (example: Director of Dissertation and Graduate Coordinator), then each role should be listed under a single entry, that is, do not list the same individual twice-just add an additional line with the extra role.

  See example on the following page:
Example approval page title using fictional author name and actual graduate faculty to demonstrate the content of an approval page

By

John M. Doe

Approved:

____________________________________
Thomas W. Miller, Jr.
(Director of Dissertation)

____________________________________
Jerome Goddard
(Committee Member)

____________________________________
Haimeng Zhang
(Committee Member)

____________________________________
Elton Philip Amburn
(Committee Member)

____________________________________
Kenneth D. Roskelley
(Committee Member/Graduate Coordinator)

____________________________________
Stewart L. Kramer
Dean
College of Business
Example approval page title using fictional author name and actual graduate faculty to demonstrate the content of an approval page

By

John M. Doe

Approved:

_________________________  __________________________
Thomas W. Miller, Jr.          Jerome Goddard
(Co-Major Professor)          (Co-Major Professor)

_________________________
Haimeng Zhang
(Committee Member)

_________________________
Elton Philip Amburn
(Committee Member)

_________________________
Kenneth D. Roskelley
(Committee Member)

_________________________
Stephen A. Akers,
(Committee Member)

_________________________
Rebecca G. Long
(Committee Member)

_________________________
Stewart L. Kramer
Dean
College of Business
5.2.4 Abstract

Abstracts are a brief summary of the document designed to quickly inform the reader about the general contents of the work. Due to standardization and cataloguing requirements, certain restrictions are placed on the abstract body:

- Special characters (those not found on a standard keyboard) are not allowed in the abstract. This includes, but is not limited to: ≥, ≤, Greek symbols, non-western characters, and complicated equations. Any such symbol that is needed should be written out. (Example: α should be written alpha). Exceptions may be allowed at the discretion of the Office of TD Review. This limitation is imposed by both the needs for Cataloguing and HTML consistency.

- Tables, Charts, Images, Bullets, and any other non-text entry are not allowed in abstracts. This limitation is imposed by both the needs for Cataloguing and HTML consistency.

- Masters Abstracts International (MAI) limits the word count for the body of Thesis abstracts to 150 words.

- Dissertation Abstracts International (DAI) limits the word count for the body of Dissertation abstracts to 350 words.

Because thesis and dissertation abstracts are published in ProQuest Dissertations & Theses (PQDT), sensitive material should not be part of an abstract for a restricted work.
The abstract is not counted as a page within the document and is not numbered. Finally, before each submission for review, verify that the “Pages of Study:” has the correct page number from the last page of the document.

Abstracts should be formatted as follows:

- There are no page numbers on these pages.
- Starting at the top of the page, the following entries must all be included.
  Each entry is single-spaced with a blank line following. If the entry is more than one line long (this is likely to happen only with the title), the second and following lines of the entry must be aligned with the first word after the entry colon. For example:

<table>
<thead>
<tr>
<th>Title of Study: The use of neural networks in the combining of time series forecasts with differential penalty costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>- “Name:” followed by the author’s name as found on the title page.</td>
</tr>
<tr>
<td>- “Date of Degree:” followed by the date of graduation formatted as “Month Day, Year”. For example, “August 9, 2011”</td>
</tr>
<tr>
<td>- “Institution: Mississippi State University”</td>
</tr>
<tr>
<td>- “Major Field:” followed by the program/concentration as found on the title page.</td>
</tr>
<tr>
<td>- “Major Professor:” followed by the major professor’s name. If there are co-major professors, then the second professor’s name follows immediately after the first with a comma separating.</td>
</tr>
<tr>
<td>- (If the dissertation director is not the major professor) “Dissertation Director:” followed by the dissertation director’s name. If there are co-</td>
</tr>
</tbody>
</table>

27
directors, then the second director’s name follows immediately after the first with a comma separating.

- “Title of Study:” followed by the title as worded on the title page.
- “Pages of Study:” followed by the page number of the last numbered page of the document. This is counting the appendices.
- “Candidate for the Degree of ” followed by the degree as found in the title page.

- The “Candidate for...” entry is followed by 2 or 3 blank lines, then the abstract body. The abstract body must not have equations, symbols (type out symbol names and equations), bullets, figures, and tables. Exceptions may be allowed at the discretion of the Office of TD Review.
- The abstract body is a series of one or more double-spaced paragraphs.
- The maximum size of a thesis’s abstract body is 150 words.
- The maximum size of a dissertation’s abstract body is 350 words.
- If the discipline requires key words, 2 or 3 blank lines are left between the abstract body and the key words.
- The key words are single-spaced and indented like an abstract entry. They are written “Key words:” followed by a comma-separated list of key words.
- The page after the last page of the abstract is page “ii”. The pages after that are numbered sequentially with lower-case Roman numerals until the page just before the first page of Chapter I (see 5.3.1 First Page of Each Chapter).

See example on the following page:
Name: Morgan Beverly Wilder
Date of Degree: December 9, 1998
Institution: Mississippi State University
Major Field: Business Administration (Finance)
Major Professor: Dr. Peter F. Strauss
Title of Study: The use of neural networks in the combining of time series forecasts with differential penalty costs
Pages in Study: 187
Candidate for Degree of Doctor of Philosophy

The need for accurate forecasting and its potential benefits are well established in the literature. Virtually all individuals and organizations have at one time or another made decisions based on forecasts of future events. This widespread need for accurate predictions has resulted in considerable growth in the science of forecasting. To a large degree, practitioners are heavily dependent on academicians for generating new and improved forecasting techniques.

In response to an increasingly dynamic environment, more diverse and complex forecasting methods have been proposed to more accurately predict future events. These methods, which focus on the different characteristics of historical data, have ranged in complexity from simplistic to very sophisticated mathematical computations requiring a high level of expertise. By combining individual techniques in order to improve on the forecasting accuracy, researchers have taken advantage of the various strengths of these techniques. A number of combining methods have proven to yield better forecasts than
individual methods, with the complexity of the various combining methods ranging from a simple average to quite complex weighting schemes.

The focus of this study is to examine the usefulness of neural networks in composite forecasting. Emphasis is placed on the effectiveness of two neural networks (i.e., a back propagation neural network and a modular neural network) relative to 3 traditional composite models (i.e., a simple average, a constrained mathematical programming model, and an unconstrained mathematical programming model) in the presence of four penalty cost functions for forecasting errors.

Specifically, the overall objective of this study is to compare the short-term predictive ability of each of the five composite forecasting techniques on various first-order autoregressive models, taking into account penalty cost functions representing four different situations. The results of this research suggest that in the vast majority of scenarios examined in this study, the neural network model clearly outperformed the other composite models.

Key words: neural networks, forecasting, autoregression
5.2.5  Dedication (Optional)

As an optional page, the author may choose to add a Dedication page as a means to recognize individual people, groups, and/or organizations that supported/inspired the author. If a dedication is used, it immediately follows the abstract and is the first numbered page (numbered with a lowercase Roman numeral “ii”).

Format requirements for a Dedication page are as follows:

- There must be 2” of blank space between the top of the first page of the Dedication and the top of “DEDICATION”.
- “DEDICATION” must be centered, in all caps, and not bold.
- Keep 2 or 3 blank lines between “DEDICATION” and the first line of the Dedication text.
- If the Dedication has not been omitted, the first page of the Dedication is page “ii” (lower-case Roman numeral)

See example on the following page:
DEDICATION

I would like to dedicate this research to my parents, Frederick and Hanna Wilder, and my brother Jason.
5.2.6 Acknowledgements (Optional)

As an optional page, the author may choose to add an Acknowledgements page to recognize any special contributors that helped make the work possible. If an acknowledgements is used, it immediately follows the dedication (if applicable, otherwise after the abstract) and continues page numbering (or if there is not a Dedication, then the first page of the Acknowledgements is numbered with a lowercase Roman numeral “ii”)

Format requirements for an Acknowledgements page are as follows:

- There must be 2” of blank space between the top of the first page of the Acknowledgements and the top of “ACKNOWLEDGEMENTS”.
- “ACKNOWLEDGEMENTS” must be centered, in all caps, and not bold.
- Keep 2 or 3 blank lines between “ACKNOWLEDGEMENTS” and the first line of the Acknowledgements text.
- The Acknowledgments text must be in paragraphs formatted as described in the “GENERAL” section

See example on the following page:
ACKNOWLEDGEMENTS

The author expresses his sincere gratitude to the many people without whose selfless assistance this dissertation could not have materialized. First of all, sincere thanks are due to Dr. Peter F. Strauss, my committee chairman, for his magnanimity in expending time and effort to guide and assist me throughout the intricacies of the doctoral program and the dissertation process. Expressed appreciation is also due to the other members of my dissertation committee, namely, Dr. Bailey R. Keenan, Dr. Taylor M. O’Leary, Dr. Rong-Jen Lin, and Dr. Kelly C. Darden, for the invaluable aid and direction provided by them. Finally, the author would like to thank Dr. Herbert Hubbell of the University of North Carolina for making available the computer program for the computation of the BDS statistics used in this study.
5.2.7 Table of Contents

A Table of Contents (TOC) serves two important roles. First, the TOC is a quick reference to all important sections of the document. Second, the TOC presents an outline of the document. From this second perspective, chapters serve as the primary points of the outline and headings represent subordinate points. The formatting of the TOC is meant to reflect these relationships with the differing levels of the outline being represented through consistent vertical alignments. Also, given the capabilities of electronic media in regards to copy/paste and search utilities, it is imperative that all entries in the TOC exactly match their referenced counterparts in the document with respect to capitalization, spelling, wording, super/subscripts, and punctuation. For most word processors, using copy and paste to replicate an entry from the body to the TOC will guarantee this matching. Typing each entry by hand introduces human error as typos, word swapping, singular/plural mix-ups, and other forms of mismatches—this is not recommended. Finally, before each submission for review, verify that all page numbers referenced in the TOC are accurate.

The titles and numbers of chapters and subsections listed in the table of contents must be worded, capitalized, and punctuated exactly as they appear in the body of the document. The table of contents indicates the page on which each heading and subheading appears.

Format requirements for the TOC are as follows:

- There must be 2” of blank space between the top of the first page of the Table of Contents and the top of “TABLE OF CONTENTS”.
- “TABLE OF CONTENTS” must be centered, in all caps, and not bold.
• Keep 2 or 3 blank lines between “TABLE OF CONTENTS” and the first entry of the Table of Contents.

• All entries should have a dot leader extending from the last word of the entry title to the entry page number (which is right-aligned with the right margin). In Word, this should be done with a right tab stop at 6” with leader style 2 (do NOT use periods).

• The right edge all lines of the entry title cannot extend past the left edge of the entry page number. In Word, a right indent of 0.5” will ensure this.

• All entries of the same level must align with each other. For example, all chapter entries are of the same level; thus, their chapter numbers must align with each other and the first words of their titles must align. Similarly, all entries for headings must align with the other entries for headings of the same level.

• Capitalization and spelling of all entries must match that of the entire corresponding item. In Word, copy and paste will ensure this.

• Entries must be normal text save for discipline-specific formatting, e.g., italicizing scientific names, bolded chemical numbers. NOTE: Superscripts and subscripts must be preserved.

• There must be preliminary section entries for (if these sections are in your document) the Dedication, Acknowledgements, List of Tables, List of Figures, and any additional preliminary sections placed after the List of Figures. No entry is added for the Table of Contents.

• Preliminary section entries must be fully left aligned and single-spaced with one blank line below them.
• After the blank line following the last preliminary section entry, add the word “CHAPTER” (all caps, normal text, left-aligned, no dot leader or page number following) with one blank line below it, followed by the entry for Chapter I.

• Chapter entries consist of:
  o The chapter number (in Roman numerals or Arabic, depending on the format in the body) followed by a decimal point. The decimal must be aligned under the “P” in the word “CHAPTER” above Chapter I’s entry. In Word, this is measured 0.43” from the left margin.
  o The chapter title, single-spaced. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”
  o One blank line between the chapter entry and the next entry.

• Section entries are single-spaced, with no blank lines below them (unless it is the last entry in the chapter, in which case one blank line is placed between it and the following entry).

• If bibliographic sections are placed at the end of each chapter, then the reference section entries are formatted as first-level-heading entries. If there is one (or more) bibliographic section for the entire document, then the corresponding entry is formatted like that of a preliminary section (including the one blank line following).

For documents with one or more appendices:

• Appendix entries are placed at the end of the Table of Contents
• Add the word “APPENDIX” (all caps, normal text, left-aligned, no dot leader or page number following) with one blank line below it, followed by the entry for Appendix A.

• Appendix entries are formatted the same as chapter entries, save that the chapter number is replaced by an appendix letter.

• Section entries in the appendices are formatting the same as section entries in the body.

For documents with un-numbered headings:

• Any lines of the entry title after the first are indented 0.5” to the right of the first letter of the entry title (not the chapter number).

• First-level-heading entries are aligned with the titles of chapter entries.

• Lower-level-heading entries are aligned 0.25” to the right of the entries one level higher, e.g. second-level entries are 0.25” to the right of first-level entries, and third-level entries are 0.25” to the right of second-level entries.

For documents with numbered headings:

• Any lines of the entry title after the first are aligned with the first letter of the entry title (not the chapter or section number). This is called “block alignment”

• First-level-heading entries consist of:
  o A section number, left-aligned with the first letter of the chapter entry titles.
  o A section title. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”
• Lower-level-heading entries are aligned 0.25” to the right of the entries one level higher, e.g. second-level entries are 0.25” to the right of first-level entries, and third-level entries are 0.25” to the right of second-level entries. NOTE: As section numbers get longer at lower levels, those section titles will move more than 0.25” to the right of the previous level’s titles. Keep these titles aligned with other titles of the same level.

See examples on the following pages:
TABLE OF CONTENTS

DEDICATION .................................................................................................................... ii
ACKNOWLEDGEMENTS ............................................................................................... iii
LIST OF TABLES ........................................................................................................... viii
LIST OF FIGURES ........................................................................................................... ix
NOMENCLATURE .......................................................................................................... xi

CHAPTER

I. INTRODUCTION .........................................................................................................1
   Background ..............................................................................................................1
   Energy and Emission Regulations Overview .......................................................2
   Motivation and Objective .....................................................................................4
   Organization of the Work .....................................................................................5

II. LITERATURE REVIEW ...........................................................................................6
   Diesel Spray Basis ..................................................................................................6
   Recent Developments in Diesel Spray Combustion .............................................9
      Dec’s Conceptual Model ...................................................................................9
      In-Depth Understanding of Dec’s Model ..........................................................14
      Concluding Remarks .......................................................................................17
   Recent Developments in Diesel Spray Structure ...............................................18
      Spray Tip Penetration ......................................................................................19
      The Liquid Length ...........................................................................................21
      The Lift-off Length ...........................................................................................24
      The Flame Length ...........................................................................................26
      Concluding Remarks .......................................................................................28
   Review on Some Important Topics ........................................................................29
      Comparison Between Gas Jets and Diesel Spray Jets ....................................29
      Air Entrainment .................................................................................................32
      Fuel Vaporization .............................................................................................33
      Relationship Between Vaporization and Combustion .....................................35
      Lift-off Stabilization Mechanism .......................................................................36
End of Injection Behaviors .................................................................43
Liquid and Lift-off Lengths at Unsteady Conditions .........................43
Summary ............................................................................................45

III. SUB MODELS DEVELOPMENT ..................................................48

Introduction ......................................................................................48
Brief Review of Phenomenological Modeling ........................................50
“Old” Phenomenological Models ...........................................................50
“New” Phenomenological Models .........................................................53
Sub Models Development ...................................................................57
Diesel Spray Model ...........................................................................58
  The Spray Penetration Model .................................................................58
  The Liquid Length Model ................................................................................60
  The Lift-off Length Model ................................................................................61
Ignition Delay Models ........................................................................63
Air Entrainment Model ........................................................................65
Combustion Model ..............................................................................69
  The Diffusion Combustion Model .................................................................69
  The Premixed Combustion Model .................................................................71

IV. ZONES DEVELOPMENT ............................................................74

Model Conception .............................................................................74
Fuel Injection Rate Profile ...................................................................77
Ignition Delay Period ..........................................................................78
First Stage Combustion .......................................................................79
  Diffusion Combustion ................................................................................81
  Premixed Combustion ...............................................................................83
  Mass Transfer Between Diffusion and Premixed Combustion
    Packets .....................................................................................................84
Quasi Steady Portion ...........................................................................86
Solution Procedures .............................................................................88

V. RESULTS AND DISCUSSION .......................................................91

The Spray Model Results ...................................................................91
  Spray Tip Penetration ...............................................................................91
  The Liquid Length ....................................................................................95
Matching Motoring Pressure Curve ......................................................100
Ignition Delay Model Results ..............................................................104
Model Parameter Calibration ...............................................................109
Temperature Distribution ...................................................................112
| VI. SUMMARY AND CONCLUSIONS ............................................................116 |
| Summary ........................................................................................................116 |
| Conclusions ....................................................................................................117 |
| VII. RECOMMENDATIONS FOR FUTURE WORK ........................................119 |
| General Limitations .......................................................................................119 |
| Suggestions on the Spray Model.................................................................120 |
| Suggestions on the Combustion Mode ..........................................................121 |
| REFERENCES ................................................................................................................123 |

APPENDIX

A COMPARISON BETWEEN SIEBERS’ AND WAKURI’S MODELS......129

B FIND B USING LEE-KESLER’S CORRESPONDING STATES..............136

Compressibility ..............................................................................................137
Specific Enthalpy ............................................................................................140
Saturation Pressure .........................................................................................141
Numerical Procedure .....................................................................................141

C MASS AND ENERGY BALANCE EQUATIONS .................................142

Overall Mass and Energy Balance Equations .............................................143
Ignition Delay Period .....................................................................................144
First Stage Combustion ..................................................................................144
Second Stage Combustion .............................................................................150

D COMBUSTION EQUILIBRIUM CALCULATIONS ...............................153

Motivations ....................................................................................................154
Determine the Products Composition .........................................................154
Determine the Adiabatic Flame Temperature .............................................157
Results and Discussions .............................................................................158
TABLE OF CONTENTS

DEDICATION .................................................................................................................... ii
ACKNOWLEDGEMENTS ............................................................................................... iii
LIST OF TABLES ........................................................................................................... viii
LIST OF FIGURES ........................................................................................................... ix
NOMENCLATURE .......................................................................................................... xi

CHAPTER

I. INTRODUCTION .............................................................................................1
   1.1 Background ............................................................................................1
   1.2 Energy and Emission Regulations Overview ........................................2
   1.3 Motivation and Objective ......................................................................4
   1.4 Organization of the Work ......................................................................5

II. LITERATURE REVIEW ..................................................................................6
   2.1 Diesel Spray Basis .................................................................................6
   2.2 Recent Developments in Diesel Spray Combustion ..............................9
      2.2.1 Dec’s Conceptual Model .................................................................9
      2.2.2 In-Depth Understanding of Dec’s Model ......................................14
      2.2.3 Concluding Remarks ....................................................................17
   2.3 Recent Developments in Diesel Spray Structure .................................18
      2.3.1 Spray Tip Penetration ..................................................................19
      2.3.2 The Liquid Length .......................................................................21
      2.3.3 The Lift-off Length .......................................................................24
      2.3.4 The Flame Length .......................................................................26
      2.3.5 Concluding Remarks ....................................................................28
   2.4 Review on Some Important Topics ......................................................29
      2.4.1 Comparison Between Gas Jets and Diesel Spray Jets ...............29
      2.4.2 Air Entrainment ...........................................................................32
      2.4.3 Fuel Vaporization .........................................................................33
      2.4.4 Relationship Between Vaporization and Combustion ...............35
      2.4.5 Lift-off Stabilization Mechanism ................................................36
      2.4.6 End of Injection Behaviors ............................................................43

Table of Contents with Numbered Headings p. 43
# Table of Contents

2.4.7  Liquid and Lift-off Lengths at Unsteady Conditions ................................................. 43
2.5  Summary .................................................................................................................. 45

III.  SUB MODELS DEVELOPMENT ................................................................................. 48

3.1  Introduction ............................................................................................................. 48
3.2  Brief Review of Phenomenological Modeling ............................................................. 50
3.2.1  “Old” Phenomenological Models ....................................................................... 50
3.2.2  “New” Phenomenological Models ..................................................................... 53
3.3  Sub Models Development ........................................................................................ 57
  3.3.1  Diesel Spray Model .......................................................................................... 58
    3.3.1.1  The Spray Penetration Model .................................................................. 58
    3.3.1.2  The Liquid Length Model ...................................................................... 60
    3.3.1.3  The Lift-off Length Model ................................................................... 61
  3.3.2  Ignition Delay Models ...................................................................................... 63
  3.3.3  Air Entrainment Model .................................................................................... 65
  3.3.4  Combustion Model ............................................................................................ 69
    3.3.4.1  The Diffusion Combustion Model ............................................................ 69
    3.3.4.2  The Premixed Combustion Model ........................................................... 71

IV.  ZONES DEVELOPMENT ............................................................................................ 74

4.1  Model Conception .................................................................................................... 74
4.2  Fuel Injection Rate Profile ....................................................................................... 77
4.3  Ignition Delay Period ............................................................................................... 78
4.4  First Stage Combustion ............................................................................................ 79
    4.4.1  Diffusion Combustion ................................................................................... 81
    4.4.2  Premixed Combustion .................................................................................. 83
    4.4.3  Mass Transfer Between Diffusion and Premixed Combustion Packets .......... 84
4.5  Quasi Steady Portion ............................................................................................... 86
4.6  Solution Procedures ................................................................................................ 88

V.  RESULTS AND DISCUSSION .................................................................................. 91

5.1  The Spray Model Results .......................................................................................... 91
    5.1.1  Spray Tip Penetration ..................................................................................... 91
    5.1.2  The Liquid Length ......................................................................................... 95
5.2  Matching Motoring Pressure Curve ......................................................................... 100
5.3  Ignition Delay Model Results ................................................................................ 104
5.4  Model Parameter Calibration .................................................................................. 109
5.5  Temperature Distribution ........................................................................................ 112

VI.  SUMMARY AND CONCLUSIONS ........................................................................... 116

6.1  Summary .................................................................................................................. 116
6.2  Conclusions .............................................................................................................. 117
VII. RECOMMENDATIONS FOR FUTURE WORK ........................................119

  7.1 General Limitations ...........................................................................119
  7.2 Suggestions on the Spray Model........................................................120
  7.3 Suggestions on the Combustion Mode ..............................................121

REFERENCES ................................................................................................................123

APPENDIX

  A   COMPARISON BETWEEN SIEBERS’ AND WAKURI’S MODELS ......129

  B   FIND B USING LEE-KESLER’S CORRESPONDING STATES ..........136

      B.1 Compressibility.................................................................137
      B.2 Specific Enthalpy..............................................................140
      B.3 Saturation Pressure...........................................................141
      B.4 Numerical Procedure........................................................141

  C   MASS AND ENERGY BALANCE EQUATIONS .........................142

      C.1 Overall Mass and Energy Balance Equations .......................143
      C.2 Ignition Delay Period........................................................144
      C.3 First Stage Combustion.....................................................144
      C.4 Second Stage Combustion ...............................................150

  D   COMBUSTION EQUILIBRIUM CALCULATIONS .......................153

      D.1 Motivations .........................................................................154
      D.2 Determine the Products Composition ..................................154
      D.3 Determine the Adiabatic Flame Temperature .....................157
      D.4 Results and Discussions ....................................................158
5.2.8 List of Tables

A List of Tables (LOT) is the quick reference list for all titled tables in a document (including those in the Appendices). If a document does not contain any titled tables, then there will not be a LOT. Given the capabilities of electronic media in regards to copy/paste and search utilities, it is imperative that all entries in the LOT exactly match their referenced counterparts in the document in regards to capitalization, spelling, wording, super/subscripts, and punctuation. For most word processors, using copy and paste to replicate an entry from the body to the LOT will guarantee this matching. Typing each entry by hand introduces human error as typos, word swapping, singular/plural mix-ups, and other forms of mismatches—this is not recommended. Also, table titles should be short, concise, and unique descriptors for a table. Finally, before each submission for review, verify that all page numbers referenced in the TOC are accurate.

Formatting for multiple line entries in the LOT is contingent upon whether headings in the document were numbered or not. Format requirements for the LOT are as follows:

- There must be 2” of blank space between the top of the first page of the List of Tables and the top of “LIST OF TABLES”.
- “LIST OF TABLES” must be centered, in all caps, and not bold.
- Keep 2 or 3 blank lines between “LIST OF TABLES” and the first entry of the List of Tables.
- All entries should have a dot leader extending from the last word of the entry title to the entry page number (which is right-aligned with the right
margin). In Word, this should be done with a right tab stop at 6” with leader style 2 (do NOT use periods).

- The right edge all lines of the entry title cannot extend past the left edge of the entry page number. In Word, a right indent of 0.5” will ensure this.
- Capitalization and spelling of all entries must match that of the entire corresponding item. In Word, copy and paste will ensure this.
- Entries must be normal text save for discipline-specific formatting, e.g., italicizing scientific names, bolded chemical numbers. NOTE: Superscripts and subscripts must be preserved.
- Each table entry is single-spaced and consists of:
  - The table number. If tables are numbered sequentially, the entry numbers are right aligned with each other. If tables are numbered by chapter/appendix, the entry numbers are aligned by the period in the middle of the number.
  - The table title. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”
  - One blank line between this entry and the next one

For documents with un-numbered headings in the Table of Contents:
- Any lines of the entry title after the first are indented 0.5” to the right of the first letter of the entry title (not the entry number).

For documents with numbered headings in the Table of Contents:
- Entry titles are block aligned.

See examples on the following pages:
LIST OF TABLES

1. Different dependencies of spray angle, liquid, and lift-off lengths ..................46
2. Coefficients used for different temperature ranges from Hernandez et al. (2010) ........................................................................................................................................65
3. Parameters used for n-heptane, obtained from Westbrook and Dryer (1981) ........................................................................................................................................73
4. Zone properties during ID period ........................................................................79
5. Zone properties during 1st stage combustion period .........................................81
6. Zone properties during quasi steady period ......................................................88
7. Comparisons between Wakuri’s and Siebers’ Analyses ....................................92
8. Model Parameters for the Motoring Case ........................................................101
9. Model Parameters used in the ignition delay model ........................................104
10. Validations of ignition delay models against experiments .............................105
11. Model parameters used to determine how much of the mass in preparing zone needs to be retained .................................................................111
12. Model parameters used for the mass transfer from diffusion packets ..........112
13. Packet index and timings at which the diffusion flame packets are formed ......112
14. Comparison between Wakuri’s and Siebers’ Analyses ....................................135
15. Constants used in Equations (B.3) and (B.4) ...................................................139
LIST OF TABLES

2.1 Different dependencies of spray angle, liquid, and lift-off lengths ...............46

3.1 Coefficients used for different temperature ranges from Hernandez et al. (2010).........................................................................................................................65

3.2 Parameters used for n-heptane, obtained from Westbrook and Dryer (1981)..............................................................................................................................73

4.1 Zone properties during ID period .......................................................................79

4.2 Zone properties during 1st stage combustion period ........................................81

4.3 Zone properties during quasi steady period .......................................................88

5.1 Comparisons between Wakuri’s and Siebers’ Analyses......................................92

5.2 Model Parameters for the Motoring Case..........................................................101

5.3 Model Parameters used in the ignition delay model ..........................................104

5.4 Validations of ignition delay models against experiments .................................105

5.5 Model parameters used to determine how much of the mass in preparing zone needs to be retained .................................................................111

5.6 Model parameters used for the mass transfer from diffusion packets ..............112

5.7 Packet index and timings at which the diffusion flame packets are formed ......112

A.1 Comparison between Wakuri’s and Siebers’ Analyses ....................................135

B.1 Constants used in Equations (B.3) and (B.4) ..................................................139
## LIST OF TABLES

2.1 Different dependencies of spray angle, liquid, and lift-off lengths .......................46

3.1 Coefficients used for different temperature ranges from Hernandez et al. (2010).....................................................................................................................65

3.2 Parameters used for n-heptane, obtained from Westbrook and Dryer (1981).....................................................................................................................................73

4.1 Zone properties during ID period ........................................................................79

4.2 Zone properties during 1st stage combustion period .............................................81

4.3 Zone properties during quasi steady period ...........................................................88

5.1 Comparisons between Wakuri’s and Siebers’ Analyses.........................................92

5.2 Model Parameters for the Motoring Case............................................................101

5.3 Model Parameters used in the ignition delay model ..............................................104

5.4 Validations of ignition delay models against experiments ....................................105

5.5 Model parameters used to determine how much of the mass in preparing zone needs to be retained .....................................................................................111

5.6 Model parameters used for the mass transfer from diffusion packets ...............112

5.7 Packet index and timings at which the diffusion flame packets are formed.............112

A.1 Comparison between Wakuri’s and Siebers’ Analyses .........................................135

B.1 Constants used in Equations (B.3) and (B.4)............................................................139
5.2.9 List of Figures

A List of Figures (LOF) is the quick reference list for all titled figures in a document (including those in the Appendices). If a document does not contain any titled figures then there will not be a LOF. Given the capabilities of electronic media in regards to copy/paste and search utilities, it is imperative that all entries in the LOF exactly match their referenced counterparts in the document in regards to capitalization, spelling, wording, super/subscripts, and punctuation. For most word processors, using copy and paste to replicate an entry from the body to the LOF will guarantee this matching. Typing each entry by hand introduces human error as typos, word swapping, singular/plural mix-ups, and other forms of mismatches—this is not recommended. Also, figure titles should be short, concise, and unique descriptors for a figure. Finally, before each submission for review, verify that all page numbers referenced in the TOC are accurate.

Formatting for multiple line entries in the LOF is contingent upon whether headings in the document were numbered or not. Format requirements for the LOF are as follows:

- There must be 2” of blank space between the top of the first page of the List of Figures and the top of “LIST OF FIGURES”.
- “LIST OF FIGURES” must be centered, in all caps, and not bold.
- Keep 2 or 3 blank lines between “LIST OF FIGURES” and the first entry of the List of Figures.
- All entries should have a dot leader extending from the last word of the entry title to the entry page number (which is right-aligned with the right
margin). In Word, this should be done with a right tab stop at 6” with leader style 2 (do NOT use periods).

- The right edge all lines of the entry title cannot extend past the left edge of the entry page number. In Word, a right indent of 0.5” will ensure this.

- Capitalization and spelling of all entries must match that of the entire corresponding item. In Word, copy and paste will ensure this.

- Entries must be normal text save for discipline-specific formatting, e.g., italicizing scientific names, bolded chemical numbers. NOTE: Superscripts and subscripts must be preserved.

- Each figure entry is single-spaced and consists of:
  - The figure number. If figures are numbered sequentially, the entry numbers are right aligned with each other. If figures are numbered by chapter/appendix, the entry numbers are aligned by the period in the middle of the number.
  - The figure title. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”
  - One blank line between this entry and the next one

For documents with un-numbered headings in the Table of Contents:

- Any lines of the entry title after the first are indented 0.5” to the right of the first letter of the entry title (not the entry number).

For documents with numbered headings in the Table of Contents:

- Entry titles are block aligned.

See examples on the following pages:
LIST OF FIGURES

1  Energy consumption by fuel from 1980 to 2035. ...................................................3
2  Primary energy flow by source and sector, 2009. ..................................................3
3  Heavy duty diesel engine emissions standards .......................................................4
4  A typical full cone diesel spray structure ..............................................................7
5  A typical heat release rate curve for diesel combustion .......................................11
6  The conceptual model of DI diesel combustion during the quasi steady period . .................................................................14
7  Comparison between the liquid and lift-off lengths ...........................................36
8  Five zone model proposed by Asay et al. ..............................................................54
9  Six zone model proposed by Maiboom et al. .........................................................56
10 Evolution of various zones in different combustion stages ..................................76
11 Proposed fuel injection rate history for simulations ...........................................77
12 Zone descriptions during the ID period ...............................................................78
13 Zone descriptions during the 1st stage combustion period ..................................80
14 Hypothetical mass transfer process between the diffusion and premixed combustion packets. ..........................................................85
LIST OF FIGURES

1.1 Energy consumption by fuel from 1980 to 2035. ....................................................3
1.2 Primary energy flow by source and sector, 2009. ...................................................3
1.3 Heavy duty diesel engine emissions standards .......................................................4
2.1 A typical full cone diesel spray structure .................................................................7
2.2 A typical heat release rate curve for diesel combustion ...........................................11
2.3 The conceptual model of DI diesel combustion during the quasi steady period. .................................................................14
2.4 Comparison between the liquid and lift-off lengths ................................................36
3.1 Five zone model proposed by Asay et al. ...............................................................54
3.2 Six zone model proposed by Maiboom et al. ..........................................................56
4.1 Evolution of various zones in different combustion stages ...................................76
4.2 Proposed fuel injection rate history for simulations ..........................................77
4.3 Zone descriptions during the ID period .................................................................78
4.4 Zone descriptions during the 1st stage combustion period ....................................80
4.5 Hypothetical mass transfer process between the diffusion and premixed combustion packets. .................................................................85
LIST OF FIGURES

1.1 Energy consumption by fuel from 1980 to 2035. ....................................................3
1.2 Primary energy flow by source and sector, 2009. ....................................................3
1.3 Heavy duty diesel engine emissions standards .......................................................4

2.1 A typical full cone diesel spray structure ..............................................................7
2.2 A typical heat release rate curve for diesel combustion ........................................11
2.3 The conceptual model of DI diesel combustion during the quasi steady period. .........................................................................................................................14
2.4 Comparison between the liquid and lift-off lengths .............................................36

3.1 Five zone model proposed by Asay et al. ..............................................................54
3.2 Six zone model proposed by Maiboom et al. ........................................................56

4.1 Evolution of various zones in different combustion stages ..................................76
4.2 Proposed fuel injection rate history for simulations ............................................77
4.3 Zone descriptions during the ID period ..................................................................78
4.4 Zone descriptions during the 1st stage combustion period ...................................80
4.5 Hypothetical mass transfer process between the diffusion and premixed combustion packets. ........................................................................................................85
5.2.10 List of Symbols, Abbreviations, Special Nomenclature, and Other Preliminary Pages

Some disciplines will require additional preliminary content that is not explicitly covered in the Standards. The following are some general guidelines for formatting such pages:

- There must be 2” of blank space between the top of the first page of the preliminary section and its title.
- The title must be centered, in all caps, and not bold.
- Keep 2 or 3 blank lines between the title and the rest of the preliminary section.
- Keep the vertical alignment of entries within this section consistent.
- If the entries consist of item numbers followed by items titles, follow the same rules as the List of Tables and List of Figures.

See example on following pages:
NOMENCLATURE

IC    Internal Combustion
DI    Direct Injection
SI    Spark-Ignited
IVC   Intake Valve Closure
SOI   Start of Injection
EOI   End of Injection
EGR   Exhaust Gas Recirculation
LHF   Local Homogeneous Flow
BMEP  Brake Mean Effective Pressure
CO₂   Carbon Dioxide
H₂O   Water
N₂    Nitrogen
O₂    Oxygen
V     Volume
T     Temperature
P     Pressure
CH₄   Methane
CₙHₘO₁Nₖ Generic Fuel
H  Monatomic Hydrogen
O  Monatomic Oxygen
N  Monatomic Nitrogen
H₂  Hydrogen
OH  Hydroxyl
CO  Carbon Monoxide
NO  Nitrogen Oxide
xᵢ  Mole Fractions of Species
Rᵤ  Universal Gas Constant
h  Specific Enthalpy
NOₓ  Oxides of Nitrogen
m  Mass
fₛ  Actual Air to Fuel Ratio
MW  Molecular Weight
X  Molar Fraction
Y  Mass Fraction
Z  Compressibility

**Greek**

α  Model Constants
β  Model Constants
γ  Model Constants
θ  Full Cone Angle of Spray or Crank Angle
ρ  Density
5.3 **Main Body**

The main body of the thesis/dissertation contains the written description of the full research done by the author. The work will be split into chapters that conform to an appropriate organization as set by the author’s discipline/department. Chapters may be further divided through the use of headings. For the purposes of these Standards, the 1\(^{st}\) level of division within the chapter is referred to as the 1\(^{st}\) level headings. 1\(^{st}\) level headings may be further divided with 2\(^{nd}\) level headings, which must be easily distinguishable from 1\(^{st}\) level headings. 2\(^{nd}\) level headings may be further divided with 3\(^{rd}\) level headings, and so forth. 4\(^{th}\) level headings are uncommon and 5\(^{th}\) level headings are very rare for most documents. Serious consideration for the layout of the document should be taken before utilizing headings beyond the 5\(^{th}\) level.

Inclusion of content not explicitly allowed or prohibited by these Standards is permissible so long as such items are consistently formatted throughout the entire document and such content has a professional appearance.

5.3.1 **First Page of Each Chapter**

There are specific format requirements for the first page of each chapter that are meant to distinguish such pages visually. These requirements are:

- There must be 2” of blank space between the top of the first page of the chapter and the top of the word “CHAPTER” and the chapter number.
- The word “CHAPTER” is followed by one space and the chapter number. The chapter number may be a Roman numeral (preferred) or an Arabic numeral, but must be the same style for all chapters.
• The word “CHAPTER” and the chapter number must be centered, in all caps, and not bold.

• Leave one blank line between the word “CHAPTER” and the chapter title.

• The chapter title must be centered, in all caps, and not bold. If the title is more than one line, it must be double-spaced and each line of the title shorter than the line above it.

• Leave two or three blank lines below the chapter title.

• The first page of chapter I must be numbered “1”.

See example on next page.
CHAPTER I
INTRODUCTION

Accurate predictions of the future can yield significant advantages and outstanding opportunities. However, these benefits will not be realized unless one anticipates and evaluates possible future events and makes appropriate strategic decisions today. Because of this need to generate information today that reflects expected outcomes in the future, forecasting has developed into an extremely important and useful activity which, in recent years, has taken on an additional dimension of complexity. Furthermore, since virtually all individuals and organizations have at one time or another made a decision based on a forecast of future events, forecasting has diverse strategic uses. Business executives, government policy-makers, and individuals all face an uncertain future, which, if ignored or ineffectively evaluated, will lead to inevitable failures. From this widespread need for accurate prediction, the science of forecasting has grown considerably, particularly in the past thirty years. Numerous articles are published each year on various aspects of forecasting. These studies appear in journals such as the following: *Journal of Forecasting, International Journal of Forecasting, Management Science, Operational Research Quarterly, Decision Sciences,* and *Interfaces,* among others. To a large degree, practitioners are heavily dependent on academicians for generating new and improved forecasting techniques.
5.3.2 Headings

Headings are used to divide chapters and higher order headings into logical subparts. Heading titles should be brief, concise descriptors for the section that they are labeling. Multiple levels of headings may be used to further differentiate key points directly relating to their preceding higher order heading. That is, if the content under a 1st level heading is split among multiple 2nd level headings, those subordinate headings should directly relate to the original 1st level heading for that section. Headings must progress in a stepwise fashion so as to avoid a jump from a 1st level heading to a 3rd level heading without first labeling a 2nd level heading to encompass the collection of 3rd level headings. It may help to think of headings as points and sub-points of an outline.

Heading levels are distinguished from one another by either numbering or unique formatting (not a combination of both, nor are they interchangeable). The method used to distinguish each level of heading must be consistent throughout the entire document, including any that may appear in an appendix. Important: if numbered headings are used, then all numbered items (tables, figures, equations, etc) must also be numbered by chapter.

The formatting rules for headings are as follows:

- There must be one blank line between a heading and the paragraph below.
- All headings must have 2 or 3 blank lines above them. The only exception: If a heading is followed by another heading, you may have one blank line between them. If you take this exception, be consistent.
- Do not place punctuation at the end of a heading.
- Do not leave a heading at the bottom of a page; such headings should be moved to the top of the next page. In Word, this is fixed by turning on the “Keep with next” option in the paragraph settings for each heading.

- If sections are numbered, headings are bold and block aligned. Section numbers must align with the left margin. Multiple line headings must be single- or double-spaced. Numbers must be Arabic and start with the chapter number followed by a decimal and then the current heading number. For lower level headings include the previous heading number and add a decimal and start the new level numbering.

- If sections are not numbered:
  
  o Each level of heading has its own unique, consistent formatting. For example, all first-level headings are formatted the same. All second-level headings are formatted the same, and this formatting must be different than that of the first-level headings, and so on.

  o Headings are left- or center-aligned (no indents) and are formatted with any combination of the following: bold, italic, underlined. Do not use normal text for a heading. Do not use all caps or small caps for a heading.

  o If you use italicized terms (like scientific names) in your headings, do not use italics for any level of heading formatting. The same goes for bold terms and bold headings. Exceptions may be allowed at the discretion of the Office of TD Review.
Multiple line headings must be single or double-spaced. If such headings are centered, they each subsequent line must be short than the previous line. See examples on the following pages.
comparison between low-sun seasons showing interannual fluctuations and trends in precipitation (Figure 8).

**Dendrochronology**

The use of dendrochronological techniques provides a way to assess the impact of El Niño on vegetation and also provides a comparison between the dendro and instrumental records. Tree cores were obtained using an increment borer from several different locations on the Alabama Coast.

**Field Collection**

At locations in Mobile and Baldwin Counties, cores were collected from 28 large trees. Using an increment borer, cores were taken from each tree at 180 degrees apart to better gauge variation in growth across the entire trunk. This provided a total of 56 cores. Upon removal, cores were placed in labeled plastic straws, and the location of each tree was noted using a GPS unit. Collection of tree cores occurred on October 26th, November 21st, and December 23rd 2002.

**Lab Analysis**

Cores were extracted and brought to the Dendroclimatology lab at MSU (A small table in room 213). Each core was mounted and glued onto narrow wooden core mounts. The cores were then sanded using a belt sander with a grade of 120 to make the rings more clearly visible and to remove debris such as mold. After sanding, the growth ring widths of each year for each core were measured to the nearest 0.001 mm using a Velmex measuring system. The Velmex system is an electronically controlled microscope stage...
that moves precisely between individual growth rings within a field of view. Velmex automatically keeps track of the distance that the stage has moved, which is used to calculate ring widths and number of rings.

**Data Analysis**

*Standardized Ring Index*

The study hinged on the creation of a standardized ring index for each year for all the trees. Using the computer program ARSTAN (Cook and Holmes, 1985) is standard procedure in dendrochronology to produce a standardized ring index. ARSTAN standardized the ring widths while crossdating the years 2 years above and below the sampled year. For example, if the year 1990 was being analyzed from one tree, the program tests to see if years from the other trees’ 1988, 1989, 1991, and 1992 values correspond better to the 1990 value. If they match better, the program sequences the years to match the correct rings together and eliminate the biases of possible false rings. Trees frequently have false rings that do not completely encircle the diameter of the cross section. In addition to this, the trees sometimes grow faster on one side versus the other side. Also, the width of growth rings naturally lessens as the tree ages so any comparison of ring widths cannot be substantiated without standardization. ARSTAN removed the natural variations in ring width with age by overlaying cubic splines onto the raw data (Cook and Holmes, 1985).
comparison between low-sun seasons showing interannual fluctuations and trends in precipitation (Figure 8).

1.1 Dendrochronology

The use of dendrochronological techniques provides a way to assess the impact of El Niño on vegetation and also provides a comparison between the dendro and instrumental records. Tree cores were obtained using an increment borer from several different locations on the Alabama Coast.

1.1.1 Field Collection

At locations in Mobile and Baldwin Counties, cores were collected from 28 large trees. Using an increment borer, cores were taken from each tree at 180 degrees apart to better gauge variation in growth across the entire trunk. This provided a total of 56 cores. Upon removal, cores were placed in labeled plastic straws, and the location of each tree was noted using a GPS unit. Collection of tree cores occurred on October 26th, November 21st, and December 23rd 2002.

1.1.2 Lab Analysis

Cores were extracted and brought to the Dendroclimatology lab at MSU (A small table in room 213). Each core was mounted and glued onto narrow wooden core mounts. The cores were then sanded using a belt sander with a grade of 120 to make the rings more clearly visible and to remove debris such as mold. After sanding, the growth ring widths of each year for each core were measured to the nearest 0.001 mm using a Velmex measuring system. The Velmex system is an electronically controlled microscope stage...
that moves precisely between individual growth rings within a field of view. Velmex automatically keeps track of the distance that the stage has moved, which is used to calculate ring widths and number of rings.

1.1.3 Data Analysis

1.1.3.1 Standardized Ring Index

The study hinged on the creation of a standardized ring index for each year for all the trees. Using the computer program ARSTAN (Cook and Holmes, 1985) is standard procedure in dendrochronology to produce a standardized ring index. ARSTAN standardized the ring widths while crossdating the years 2 years above and below the sampled year. For example, if the year 1990 was being analyzed from one tree, the program tests to see if years from the other trees’ 1988, 1989, 1991, and 1992 values correspond better to the 1990 value. If they match better, the program sequences the years to match the correct rings together and eliminate the biases of possible false rings. Trees frequently have false rings that do not completely encircle the diameter of the cross section. In addition to this, the trees sometimes grow faster on one side versus the other side. Also, the width of growth rings naturally lessens as the tree ages so any comparison of ring widths cannot be substantiated without standardization. ARSTAN removed the natural variations in ring width with age by overlaying cubic splines onto the raw data (Cook and Holmes, 1985).
5.3.3 Lists

Lists must be formatted consistently within the entire document. Bulleted, numbered, and multi-level lists are all allowed and should be used appropriately to distinguish or enumerate points that support the text. Each entry in a list must be separated by one blank line, while individual multiple line entries may either be single or double spaced. Lists should be block aligned so that the bullet or number is the left most text for an entry. Examples:

<table>
<thead>
<tr>
<th></th>
<th>This is the first entry of the numbered list</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>This is a second entry of a numbered list that consists of text that causes the entry to extend past one line and is thusly block-aligned.</td>
</tr>
<tr>
<td>a</td>
<td>This is a possible entry for a multi level list</td>
</tr>
<tr>
<td>b</td>
<td>Such multi level lists may be distinguished in any manner appropriate for the author’s field of study, so long as all such multilevel lists in the document are consistently formatted</td>
</tr>
</tbody>
</table>

Another example for a bullet list that multiple line entries are single spaced:

- This is the first entry in the bullet list
- This is a second entry in the bullet list that consists of text that causes the entry to extend past one line and is thusly block-aligned.

5.3.4 Block Quotes

Block quotes are used to distinguish long instances of quoted text from the author’s original text. Such long quotes must be separated from surrounding text by one blank line. Block quotes may be either single spaced or double spaced. All block quotes
must have equal indentations on both the left and right. If the left indents are set to 0.5 inches, then the right indents for the block quote must also be set for 0.5 inches. Indentations used for block quotes must be consistent throughout the entire document. Finally, Block quotes may be either left or fully justified.

Example double-spaced block quote that is left justified:

| This block quote is left justified and double-spaced with 0.5 inch indents on the left and right side. The next example will be for a fully justified and single-spaced block quote with 0.5 inch indents on the left and right side. |

Example of single-spaced block quote that is fully justified:

| This block quote is fully justified and single-spaced with 0.5 inch indents on the left and right side. The previous example was for a left justified and double-spaced block quote with 0.5 inch indents on the left and right side. |

5.3.5 Tables

Tables may be placed in either two locations within a document, either after the paragraph in which they are first referenced without splitting paragraphs or at the end of the chapter in which they are referenced. If the latter option is chosen, then figures should also appear after the tables at the end of the chapter.

Table titles always appear above the table. Table titles should be short, concise, and unique descriptors for a table. Detailed descriptions that describe the contents of the table should be reserved for either notes beneath the table or part of a paragraph referencing the table.
Table numbering must be consistent within the entire document and either numbered sequentially or by chapter. Note: If headings are numbered by chapter then tables must also be numbered by chapter.

The formatting rules for tables are as follows:

- Tables may not be placed in the middle of a paragraph, even if the paragraph is split between two pages.
- The table title must have 2 or 3 blank lines above it.
- Do not place table titles in a row of the table.
- Choose one of the two styles of table title:
  - Centered style: The word “Table”, one space, and the table number, centered. Below that, one blank line, then the table title, single-spaced, centered, with every line smaller than the line above. Below that, one blank line, then the table itself, centered.
  - Block style: The word “Table”, one space, then the table number, aligned with the left margin. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”. Then, the table title, single-spaced and block aligned. Below that, a blank line, then the table, left-aligned or centered (be consistent for all tables).
- The table itself is formatted according to the author’s need. Any size font, any style text is allowed, as long as the table is legible and meets departmental standards.
- The table gridlines may not extend into the margins. Word tends to get this wrong automatically. Setting the cell margins to 0” will fix this.
- Table must be in line with text (no text wrapping).
• Notes go below the table (not inside it). There may be zero or one blank line separating table from notes.

• Keep two or three blank lines below the table (or the notes, if present).

• If a table is more than one page in size (note: if a table can be placed on one page, it must be. Do not break small tables over two pages), then the table title is placed above the first page. Above the following pages of the table, place the word “Table”, a space, the table number, a space, then “(continued)”, followed by one blank line, then the piece of table for that page. Notes for a table appear below the last part of the table.

See examples on the following pages.
Table 3


<table>
<thead>
<tr>
<th>Country Index and Type of Portfolio</th>
<th><em>Mean Return</em></th>
<th>Standard Deviation $\sigma$</th>
<th>Coeff. of Var.: $\sigma/x$</th>
<th>Proportions in Portfolio:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equally Weighted Optim.</td>
</tr>
<tr>
<td>Australia</td>
<td>.1007</td>
<td>2.3246</td>
<td>23.08</td>
<td>.06</td>
</tr>
<tr>
<td>Belgium</td>
<td>.0627</td>
<td>2.2018</td>
<td>35.14</td>
<td>.06</td>
</tr>
<tr>
<td>Canada</td>
<td>-.0386</td>
<td>1.7540</td>
<td>-45.49</td>
<td>.06</td>
</tr>
<tr>
<td>Denmark</td>
<td>.0688</td>
<td>2.7323</td>
<td>39.73</td>
<td>.06</td>
</tr>
<tr>
<td>France</td>
<td>.0704</td>
<td>2.5251</td>
<td>35.85</td>
<td>.06</td>
</tr>
<tr>
<td>Germany</td>
<td>.0871</td>
<td>2.5892</td>
<td>29.72</td>
<td>.06</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>.4410</td>
<td>3.4983</td>
<td>7.93</td>
<td>.35 .20 .43 .33</td>
</tr>
<tr>
<td>Italy</td>
<td>-.0204</td>
<td>3.7920</td>
<td>-185.67</td>
<td>.06</td>
</tr>
<tr>
<td>Japan</td>
<td>-.0019</td>
<td>3.6002</td>
<td>-187.59</td>
<td>.06</td>
</tr>
<tr>
<td>Netherlands</td>
<td>.1775</td>
<td>1.8625</td>
<td>10.49</td>
<td>.20 .20 .27 .33</td>
</tr>
<tr>
<td>Norway</td>
<td>.0868</td>
<td>3.3162</td>
<td>38.19</td>
<td>.06</td>
</tr>
<tr>
<td>Singapore/Malaysia</td>
<td>.2810</td>
<td>2.7200</td>
<td>9.68</td>
<td>.11 .20</td>
</tr>
<tr>
<td>Spain</td>
<td>-.0033</td>
<td>3.3540</td>
<td>-100.73</td>
<td>.06</td>
</tr>
<tr>
<td>Sweden</td>
<td>.1143</td>
<td>3.4814</td>
<td>30.47</td>
<td>.06</td>
</tr>
<tr>
<td>Switzerland</td>
<td>.2518</td>
<td>2.3952</td>
<td>9.51</td>
<td>.21 .20 .30 .33</td>
</tr>
<tr>
<td>U. K.</td>
<td>.1213</td>
<td>2.3962</td>
<td>19.76</td>
<td>.06</td>
</tr>
<tr>
<td>U. S.</td>
<td>.1274</td>
<td>1.7087</td>
<td>13.41</td>
<td>.14 .20</td>
</tr>
<tr>
<td>Portfolio #1</td>
<td>.1103</td>
<td>‡1.7926</td>
<td><strong>16.26</strong></td>
<td>1.00</td>
</tr>
<tr>
<td>Portfolio #2</td>
<td>.2887</td>
<td>1.9986</td>
<td><strong>6.92</strong></td>
<td>1.00</td>
</tr>
<tr>
<td>Portfolio #3</td>
<td>.2549</td>
<td>1.8068</td>
<td><strong>7.09</strong></td>
<td>1.00</td>
</tr>
<tr>
<td>Portfolio #4</td>
<td>.3125</td>
<td>2.1938</td>
<td><strong>7.02</strong></td>
<td>1.00</td>
</tr>
<tr>
<td>Portfolio #5</td>
<td>.2898</td>
<td>2.0521</td>
<td><strong>7.08</strong></td>
<td>1.00</td>
</tr>
</tbody>
</table>

* Represents the mean weekly percentage rate of return.
‡ To the extent that returns on individual country indices are less than perfectly positively correlated with the returns on the portfolio, the standard deviation of a portfolio is less than the weighted average of the individual standard deviations of country indices in a portfolio.

NOTE: **Portfolio #1** consists of each one of the 17 country indices, all equally weighted in the portfolio.

**Portfolio #2** represents the overall optimum portfolio, defined as the one which minimizes the absolute value of the coefficient of variation for the portfolio.

**Portfolio #3** consists of the five country indices which make up the optimum portfolio, in this case, however, each index received equal weight in the portfolio.

**Portfolio #4** is an optimum portfolio based on the optimum three country indices.

**Portfolio #5** consists of the above 3-country index, but equally weighted.
Process Employed to Optimize the Individual Forecasting Models

FORTRAN programs (Appendix B.1-B.4) are used to optimize the four individual forecasting models (i.e., MAVG, SES, Holt’s, and Winter’s). In this study a model is considered optimal when its parameters yield a minimum mean square error (MSE) for the training data. The resulting parameters of the forecasting models are summarized in Table 4.1.

Table 4.1

Parameters for optimal individual forecasting models for simulated data

<table>
<thead>
<tr>
<th>Composite Models:</th>
<th>Individual Forecasting Parameters</th>
<th>Case #1</th>
<th>Case #2</th>
<th>Case #3</th>
<th>Case #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAVG</td>
<td>n=</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>SES</td>
<td>α=</td>
<td>0.37</td>
<td>0.37</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>Holt’s</td>
<td>α=</td>
<td>0.40</td>
<td>0.40</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>γ=</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Winter’s</td>
<td>α=</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>β=</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>γ=</td>
<td>0.40</td>
<td>0.40</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

It should be pointed out that while these four models may not be the best models to fit an AR(1) process, the purpose of this research is to compare how well various composite models perform in combining the same four individual forecasts. Therefore, as long as each of the composite models receives the same information, the specific four individual forecasting models employed should not have a significant impact on the overall comparison between the composite models.
Table 4  Testing for Differences in Rates of Return in Three Market Indices by the Day-of-the-Week and Business Cycles: Results of ANOVA and Kruskal-Wallis

\[ \text{Ho: } R_i(\text{Monday}) = R_i(\text{Tuesday}) = R_i(\text{Wednesday}) = R_i(\text{Thursday}) = R_i(\text{Friday}) \]

<table>
<thead>
<tr>
<th>Index:</th>
<th>ANOVA:</th>
<th></th>
<th>Kruskal-Wallis:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F-value</td>
<td>*P-value:</td>
<td>No. of Observ.</td>
<td>F-value:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*P-value:</td>
</tr>
<tr>
<td><strong>Junk Bonds (overall)</strong></td>
<td>4.08</td>
<td>.0027</td>
<td>1,886</td>
<td>67.56</td>
</tr>
<tr>
<td>Expansion</td>
<td>3.44</td>
<td>.0082</td>
<td>1,719</td>
<td>57.17</td>
</tr>
<tr>
<td>Contraction</td>
<td>1.15</td>
<td>.3347</td>
<td>167</td>
<td>7.97</td>
</tr>
<tr>
<td><strong>Investment-Grade Bonds</strong></td>
<td>.16</td>
<td>.9588</td>
<td>1,891</td>
<td>1.30</td>
</tr>
<tr>
<td>Expansion</td>
<td>.16</td>
<td>.9572</td>
<td>1,724</td>
<td>1.65</td>
</tr>
<tr>
<td>Contraction</td>
<td>.13</td>
<td>.9729</td>
<td>167</td>
<td>1.02</td>
</tr>
<tr>
<td><strong>CRSP Equally-Weighted</strong></td>
<td>5.83</td>
<td>.0001</td>
<td>1,770</td>
<td>38.81</td>
</tr>
<tr>
<td>Equity (overall)</td>
<td>6.36</td>
<td>.0000</td>
<td>1,603</td>
<td>39.81</td>
</tr>
<tr>
<td>Contraction</td>
<td>.82</td>
<td>.5129</td>
<td>167</td>
<td>4.68</td>
</tr>
</tbody>
</table>

*The reported F-values and associated P-values correspond to the null hypothesis of equal mean return by the day of the week

Table 5  Duncan’s Test Statistics for Pairwise Comparisons in the Daily Returns in the Three Market Indices by Business Cycles

<table>
<thead>
<tr>
<th>Index:</th>
<th>Comparison of Days With Significantly Different Returns at the .05 Level:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Junk Bonds (overall)</strong></td>
<td>Friday &gt; Monday, Tuesday, Wednesday, Thurs.</td>
</tr>
<tr>
<td>Expansion</td>
<td>Friday &gt; Monday, Tuesday, Wednesday, Thurs.</td>
</tr>
<tr>
<td>Contraction</td>
<td>(none)</td>
</tr>
<tr>
<td><strong>Investment-Grade Bonds (overall)</strong></td>
<td>(none)</td>
</tr>
<tr>
<td>Expansion</td>
<td>(none)</td>
</tr>
<tr>
<td>Contraction</td>
<td>(none)</td>
</tr>
<tr>
<td><strong>CRSP Equally-Weighted</strong></td>
<td>Monday &lt; Wednesday, Thursday, Friday</td>
</tr>
<tr>
<td>Equity (overall)</td>
<td>Tuesday &lt; Wednesday</td>
</tr>
<tr>
<td>Expansion</td>
<td>Monday &lt; Tuesday, Wednesday, Thurs., Friday</td>
</tr>
<tr>
<td>Contraction</td>
<td>Tuesday &lt; Wednesday</td>
</tr>
<tr>
<td>Contraction</td>
<td>(none)</td>
</tr>
</tbody>
</table>
5.3.6 Figures and Other Labeled Illustrations

Figures may be placed in either two locations within a document, either after the paragraph in which they are first referenced without splitting paragraphs or at the end of the chapter in which they are referenced. If the latter option is chosen, then tables should also appear before the figures at the end of the chapter.

Figure titles always appear below the figure. Figure titles should be short, concise, and unique descriptors for a figure. Detailed descriptions that describe the contents of the figure should be reserved for either notes beneath the figure title or part of a paragraph referencing the figure.

Figure numbering must be consistent within the entire document and either numbered sequentially or by chapter. Note: If headings are numbered by chapter then figures must also be numbered by chapter.

If a discipline requires, additional illustrations that are not considered figures but go by another label (such as schemes) may also be included with an appropriate label and must follow the format requirements for figures. Such illustrations should also have their own reference list after the List of Figures in the preliminary pages.

The formatting rules for figures are as follows:

- Figures may not be placed in the middle of a paragraph, even if the paragraph is split between two pages.
- The figure must have 2 or 3 blank lines above it.
- Do not place figure titles in the figure itself or a text box.
• Figures should be inserted as images. If the Office of TD Review sees
that a figure is slow in rendering, they will require the figure be replaced
with an image.

• Choose one of the two styles of figure title:
  o Centered style: Below the centered figure, one blank line, then the word
    “Figure”, one space, and the figure number, centered. Below that, one
    blank line, then the figure title, single-spaced, centered, with every line
    smaller than the line above.
  o Block style: Below the figure (centered or left-aligned, be consistent), one
    blank line, then the word “Figure”, one space, then the figure number,
    aligned with the left margin. The space separating the number from the
    title should be enough to distinguish the two, but not exceeding 0.5”.
    Then, the figure title, single-spaced and block aligned.

• The figure itself is formatted according to the author’s need as long as it is
  legible and meets departmental standards.

• If the figure has white space at the top or bottom of the image itself, it
  must be cropped or surrounded with a single-line border, i.e., no shadows,
  3-D, etc.

• Figures may not extend into the margins.

• Figures must be inserted in line with text (no text wrapping).

• Notes go below the figure title (not inside it). There must be one blank
  line separating figure title from notes.

• Keep two or three blank lines below the figure title (or the notes, if
  present).
• If a figure is more than one page in size (note: if a figure can be placed on one page, it must be. Do not break small figures over two pages), then the figure title is placed below the figure portion on the first page. Below the figure portions on the following pages, add a blank line, then place the word “Figure”, a space, the figure number, a space, then “(continued)”. Notes for a figure appear below the last “(continued)” note.

• Multiple small figures that are related may be grouped together provided that:
  o each figure contains an identifier (“a”, “b”, “c”, or equivalent identifier) inside each image.
  o the group of figures is given only 1 collective title
  o notes for the figure detail the specifics by referencing the unique labels for each figure.

See examples on the following pages.
Figure 4.6

Modular Neural Network Training Procedure
The use of mathematical programming helped to identify Portfolio #2, the one with the smallest coefficient of variation. This portfolio resulted in a remarkable reduction in the coefficient of variation relative to Portfolio #1 (i.e., 6.92 versus 16.26, respectively). In addition, the risk/return characteristics of this portfolio are significantly better than those of any individual country index. It is also of interest to note that the overall optimum portfolio required only 5 of the 17 country indices.

![Figure 4.1 Risk/Return Characteristics of Selected International Portfolios: January 1990-December 1994](image)

Relying on more relaxed assumptions, Portfolio #3’s results are quite close to those obtained for the overall optimum portfolio (coefficient of variation of 7.09 versus 6.92, respectively). Recall that Portfolio #3 relies on the same country indices as the optimum portfolio, except they are all equally weighted. So, comparing the coefficient .
3.1.4 Absorption of the Skin Mimicking Material

In order to study the absorption characteristics of the tissue mimicking materials, the following measuring set-up is performed. Two horn antennas that operate at 7-11 GHz are connected to the Agilent Technologies® E8362B PNA Network Analyzer to measure the absorption of power because of the interference or presence of a square skin mimicking gel sample. For both horn antennas, the waveguide length is 9 cm, the height is 5.8 cm, and the thickness is 8.2 cm, while the antennas’ length is 4.5 cm, the height is 1.2 cm, and the thickness is 2.5 cm. The dimensions of the square sample are 26.5 cm in height, 26.5 cm in length, and 1.02 cm in thickness. The horn antennas are placed 9.5 cm apart, and the sample is placed between the horns. Figure 3.14 shows the measurement set-up with and without a skin mimicking gel sample.

![Figure 3.14](a) Without Interference of a Skin Mimicking Sample (b) With Interference of a Skin Mimicking Sample

Figure 3.15 shows S12 and S21 from 7-11 GHz of the antennas with and without the interference of the skin mimicking sample. These measurements are performed using Agilent Technologies® E8362B PNA Network Analyzer. The difference of the S12 and S21 of the antennas with and without the sample provides the amount of energy absorbed by the material. The absorption by the skin mimicking material is shown in Figure 3.16.
5.3.7 Landscape Pages

Some tables and figures may be too wide to fit on a standard portrait page (width: 8.5” height: 11”) and are best displayed on a landscaped page (width: 11” height: 8.5”). Such pages are permissible, but must be rotated in the .pdf submission so that all pages are portrait oriented. All margin considerations and page number location must conform to the final rotated page layout. Simply, after the landscaped page is rotated in the .pdf, it should be indistinguishable from all other portrait pages.

The formatting rules for landscaped pages are as follows:

- In the PDF submission, all landscape pages must be rotated to a portrait orientation. After that, all page numbers and margins will be in the same location on the page.
- The tops of text and images on a landscape page should be oriented to the left once rotated.

See examples on the following pages.
Table 2
Weekly Rates of Return of Selected International Stock Markets by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Australia</th>
<th>France</th>
<th>Germany</th>
<th>Hong Kong</th>
<th>Japan</th>
<th>Sing./ Mal.</th>
<th>Spain</th>
<th>Sweden</th>
<th>U.K.</th>
<th>U.S.</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>5.264</td>
<td>11.61</td>
<td>2.846</td>
<td>3.047</td>
<td>8.024</td>
<td>8.046</td>
<td>1.822</td>
<td>1.901</td>
<td>3.79</td>
<td>2.037</td>
<td>3.606</td>
</tr>
<tr>
<td>1981</td>
<td>-5.163</td>
<td>-8.218</td>
<td>-2.73</td>
<td>-3.396</td>
<td>3.109</td>
<td>2.825</td>
<td>0.45</td>
<td>5.673</td>
<td>-2.961</td>
<td>-1.835</td>
<td>-1.413</td>
</tr>
<tr>
<td>1982</td>
<td>-5.887</td>
<td>-1.716</td>
<td>1.2</td>
<td>-12.351</td>
<td>-0.309</td>
<td>-4.019</td>
<td>-9.351</td>
<td>3.389</td>
<td>0.628</td>
<td>2.691</td>
<td>1.109</td>
</tr>
<tr>
<td>1983</td>
<td>7.507</td>
<td>43.468</td>
<td>3.569</td>
<td>-1.698</td>
<td>3.806</td>
<td>4.788</td>
<td>-3.201</td>
<td>7.44</td>
<td>2.009</td>
<td>2.96</td>
<td>3.23</td>
</tr>
<tr>
<td>1984</td>
<td>-3.073</td>
<td>-0.451</td>
<td>-1.531</td>
<td>5.823</td>
<td>2.763</td>
<td>-6.23</td>
<td>4.393</td>
<td>-5.221</td>
<td>-0.091</td>
<td>0.086</td>
<td>239</td>
</tr>
<tr>
<td>1987</td>
<td>0.972</td>
<td>-3.504</td>
<td>-5.576</td>
<td>-1.006</td>
<td>6.596</td>
<td>0.203</td>
<td>5.93</td>
<td>0.25</td>
<td>6.02</td>
<td>-0.155</td>
<td>2.459</td>
</tr>
<tr>
<td>1988</td>
<td>5.88</td>
<td>5.542</td>
<td>3.292</td>
<td>4.022</td>
<td>5.986</td>
<td>5.3</td>
<td>1.708</td>
<td>7.442</td>
<td>0.014</td>
<td>2.169</td>
<td>3.762</td>
</tr>
<tr>
<td>1989</td>
<td>1.12</td>
<td>5.896</td>
<td>7.122</td>
<td>1.032</td>
<td>0.391</td>
<td>6.583</td>
<td>1.544</td>
<td>4.984</td>
<td>2.958</td>
<td>4.324</td>
<td>2.625</td>
</tr>
</tbody>
</table>

NOTE: All weekly returns are converted in U.S. dollars and, for improved readability, are multiplied by 1,000.

** Weekly return based on February – December 1978.
Figure 17  Number of theses and dissertations submitted by department, 2004-2005
5.3.8 Equations

Equations may be used as part of a paragraph or separate, as appropriate. Equations that are separated from paragraphs must be numbered, using the same numbering scheme for tables and figures. For numbering purposes, only each unique equation should be numbered. A series of derivations or directly related equations should only have one number, however, such series should be vertically aligned by their major operators (e.g. equivalency signs) when possible. Due to the limitations on cataloging and html, equations are not allowed as part of a document’s title or in the abstract. It is also inadvisable to use equations in chapter, heading, table, or figure titles.

Numbering for equations must be right aligned to the right margin. The equations, themselves, must be formatted in a consistent manner. Centering equations is one method. Using a consistent left-alignment is another. For purposes of consistency, align equations series by the longest line within the series.

The formatting rules for equations are as follows:

- All equations outside of a paragraph must be numbered in the same method as the tables and figures.
- Equation numbers must be aligned with the right margin.
- Consistent spacing must be kept above and below equations.
- Equations must be aligned in one of two ways: Centered horizontally on the page, or consistently left-aligned with all other equations.
- If there are a series of equations for one equation number, the equation must be aligned by the equivalency sign or other major operator, e.g., less-than sign.
The author is responsible for verifying the proper output of the equations to the PDF. It may be beneficial for the author to convert equations to images.

See examples on the following pages.
Hence if \( \tilde{f}_1 := \sup_{[0, \infty)} \tilde{f}(s) = \frac{b_1^2 + 4a_1m_0}{4m_0} \leq \mu_1 \) or equivalently, \( a_1 < \mu_1 \) and

\[
 b_1 \leq 2\sqrt{m_0(\mu_1 - a_1)} \quad \text{then}
\]

\[
\int_{\Omega} \psi_1[a(x)u + b(x)u^2 - m(x)u^3 - ch(x)] \, dx - \int_{\Omega} [\mu_1 \psi_1 u] \, dx \leq \int_{\Omega} [\psi_1 u \tilde{f}(u) - \mu_1 \psi_1 u] \, dx - c \int_{\Omega} [h(x)\psi_1] \, dx \leq \int_{\Omega} \psi_1 u[\tilde{f}_1 - \mu_1] \, dx \leq 0 
\tag{4.4}
\]

Also, if \( \|u\|_{\infty} < \delta \) then we have,

\[
\int_{\Omega} \psi_1 [g(u) - u] \, dx \geq \int_{\Omega} \psi_1 [\delta - \|u\|_{\infty}] \, dx > 0. 
\tag{4.5}
\]

Therefore, (4.4) and (4.5) together contradict (4.2).

To prove Theorem 8(b) note that from (4.1) we have,

\[
\int_{\Omega} [\psi_1 \Delta u] \, dx = -\mu_1 \int_{\Omega} [\psi_1 u] \, dx + \int_{\partial \Omega} \psi_1 [u - g(u)] \, dx. 
\tag{4.6}
\]

By the maximum principle, every solution, \( u \), of (1.22) - (1.23) (for any \( c \geq 0 \)) must be such that \( u \leq \bar{M} \) where \( \bar{M} := \frac{b_1 + \sqrt{b_1^2 + 4m_0a_1}}{2m_0} \) is the positive zero of \( \tilde{f}(s) \). Thus we have,

\[
c \int_{\Omega} [h(x)\psi_1(x)] \, dx = \int_{\Omega} [\psi_1 (\Delta u)] \, dx + \int_{\Omega} [\psi_1[a(x)u + b(x)u^2 - m(x)u^3] \, dx
\leq -\mu_1 \int_{\Omega} [\psi_1 u] \, dx + \int_{\Omega} \psi_1 [u - g(u)] \, dx + \tilde{f}_1 \int_{\Omega} \psi_1 u \, dx
\leq \int_{\partial \Omega} \psi_1 [\bar{M} - \delta] \, dx + \tilde{f}_1 \bar{M} \int_{\Omega} \psi_1 \, dx. 
\tag{4.7}
\]

But, (4.7) cannot hold for large \( c \)-values thus proving Theorem 8(b).
Hence if \( f_1 := \sup_{[0,\infty)} \hat{f}(s) = \frac{b_1^2 + 4a_1m_0}{4m_0} \leq \mu_1 \) or equivalently, \( a_1 < \mu_1 \) and \( b_1 \leq 2\sqrt{m_0(\mu_1 - a_1)} \) then

\[
\int_\Omega \psi_1 [a(x)u + b(x)u^2 - m(x)u^3 - ch(x)] \, dx - \int_\Omega [\mu_1 \psi_1 u] \, dx \leq \\
\int_\Omega [\psi_1 u\hat{f}(u) - \mu_1 \psi_1 u] \, dx - c \int_\Omega [h(x)\psi_1] \, dx \leq \\
\int_\Omega \psi_1 u[\hat{f}_1 - \mu_1] \, dx \leq 0 \quad (4.4)
\]

Also, if \( \|u\|_\infty < \delta \) then we have,

\[
\int_\Omega \psi_1 [g(u) - u] \, dx \geq \int_\Omega \psi_1 [\delta - \|u\|_\infty] \, dx > 0. \quad (4.5)
\]

Therefore, (4.4) and (4.5) together contradict (4.2).

To prove Theorem 8(b) note that from (4.1) we have,

\[
\int_\Omega [\psi_1 \Delta u] \, dx = -\mu_1 \int_\Omega [\psi_1 u] \, dx + \int_{\partial \Omega} \psi_1 [u - g(u)] \, dx. \quad (4.6)
\]

By the maximum principle, every solution, \( u \), of (1.22) - (1.23) (for any \( c \geq 0 \)) must be such that \( u \leq \bar{M} \) where \( \bar{M} := \frac{b_1 + \sqrt{b_1^2 + 4m_0a_1}}{2m_0} \) is the positive zero of \( \hat{f}(s) \). Thus we have,

\[
c \int_\Omega [h(x)\psi_1(x)] \, dx = \int_\Omega [\psi_1 (\Delta u)] \, dx + \int_\Omega \psi_1 [a(x)u + b(x)u^2 - m(x)u^3] \, dx \leq \\
-\mu_1 \int_\Omega [\psi_1 u] \, dx + \int_{\partial \Omega} \psi_1 [u - g(u)] \, dx + \hat{f}_1 \int_\Omega \psi_1 u \, dx \\
\leq \int_{\partial \Omega} \psi_1 [\bar{M} - \delta] \, dx + \hat{f}_1 \bar{M} \int_\Omega \psi_1 \, dx. \quad (4.7)
\]

But, (4.7) cannot hold for large \( c \)-values thus proving Theorem 8(b).
5.3.9 Bibliographic Materials

Bibliographic styles are set by the conventions of the author’s discipline, except for the following:

1) each entry must be single spaced.
2) each entry must be separated by other entries by one blank line.

All other aspects (such as order of each entry, information provided, etc.) should conform to the expectations of the author’s committee.

Bibliographic material is placed in one of two possible locations, either at the end of each chapter or the end of the document following the last chapter. If placed at the end of each chapter the heading (bibliography, works cited, references, etc.) should be formatted as a 1st level heading at the start of a new page. If placed at the end of the document, then the heading will be formatted like those in the preliminary pages.

The formatting rules for bibliographic materials are as follows:

For all bibliographic sections:

- Bibliographic entries must be single-spaced with a blank line below each entry. All other formatting is to be according to departmental citation standards.
- Entries should not be split across a page break

For bibliographic sections placed at the end of each chapter:

- Start a new page.
- Format the section heading as a first-level subheading (do not use all caps), followed by one blank line, then the first bibliographic entry
For an overall bibliographic section at the end of the document:

- Start a new page.
- There must be 2” of blank space between the top of the first page of the section and the top of the section title.
- The section title must be centered, in all caps, and not bold.
- Keep 2 or 3 blank lines between the section and the first bibliographic entry.

See examples on the following pages.
2.11 References Cited


BIBLIOGRAPHY


5.4 Appendices

Appendices are for organizing and including supplemental material. Multiple appendices should be used to distinguish between disparate materials. Such materials include, but are not limited to:

- data tables
- correspondence letters
- IRB approval letters
- example surveys used
- sample code

Each appendix must have a divider page preceding its relevant material. This divider page must have the word “APPENDIX” and the letter (“A”, “B”, etc) of the appendix and a title for the appendix. If headings are used in an appendix, then they must be listed in the Table of Contents and formatted as the headings used in the main body. Note: numbered by chapter headings, would be numbered by appendix letter (A.1, A.2, etc.). Also, titled tables and figures must also be listed in the List of Tables and List of Figures, respectively. Sequentially numbered tables/figures continue their numbering in the appendices to represent the order of their appearance in the document. Tables/Figures that are numbered by chapter would be numbered by appendix letters.
The formatting rules for appendix pages are as follows:

- Appendices are lettered A, B, C, etc. If there is only one appendix, it is Appendix A.

- Every appendix is preceded by a divider page, which has the following text centered vertically and horizontally on the page:
  - The word “APPENDIX”, a space, then the appendix letter
  - one blank line
  - The appendix title, double-spaced, in all caps, with each line smaller than the line above.

- If the appendix is divided into sections, the section headings must match the format of the headings in the body.

See examples on the following pages.
APPENDIX A

DATA ON HURRICANES BEGINNING IN THE ATLANTIC BASIN AND
REACHING THE NORTH AMERICAN CONTINENT

FROM 1928 THROUGH 193
5.5 Supplemental Files

There may be instances where additional material is desired, but not viable for direct inclusion within the main document. Such items could include: large maps, multimedia files, sample programs, etc. In such cases, the author should include such materials as separate files. Each such file should have an appendix entry that either cites the file by name and/or is hyperlinked to the file (assume the file is in the same directory as the document). This appendix should also list any needed software requirements for viewing the associated supplemental file.
APPENDIX A

THESIS AND DISSERTATION SUBMISSION PROCESS
1. Be enrolled in at least 1 credit hour during the graduating semester.
4. Make all content corrections for committee.
5. Obtain all required signatures on your approval/signature page.
6. Submit your signed approval/signature page document to T/D.
8. Post your document as a PDF to your ETD account.
9. Complete and submit an ETD rights and permissions form (.pdf).
10. Complete and submit the Author Contact Form (.pdf).
    
    11. The above is required to meet the initial submission deadline

11. T/D will review your document and email you a list of corrections.
13. Submit a corrected copy to T/D (by uploading the corrected .pdf to the ETD server and emailing a confirmation to your reviewer).
14. T/D will review the corrected copy and send a list of any additional corrections.
15. Repeat steps 12 and 13 until all corrections have been made.
16. When all corrections have been made, T/D will request final submission. Final submission instructions will be provided at this time.
17. Submit your document to UMI-ProQuest for publishing (Create an account by logging in through the link that will be provided in the final submission instructions.).
18. Complete the submission process by following the ProQuest instructions.
20. Doctoral students will also need to submit graduation information (as listed in the final submission instructions).
    
    11-20 must be done by the Final approval deadline

21. Pay all T/D related fees via Banner account (this will occur when you receive the automated email message of approval from the publisher).
22. Process is complete.
APPENDIX B

AUTHOR CONTACT FORM
The Author Contact Form is intended to provide the Office of Thesis and Dissertation Format Review (T/D) with a means of contacting an author. Information submitted will be kept confidential. This information is used to assist in keeping the author informed of deadlines, submission correction requirements, and also possible errors/issues with submissions post-graduation.

In the event that a third party wishes to contact an author, T/D will obtain that party’s contact information and reason for inquiry to pass along to the author to protect the author’s privacy.

*Special note: the form on the following page is not formatted uniformly with this document and purposefully does not have a page number. As such, it is not meant as an example of proper formatting in an appendix.*
AUTHOR CONTACT FORM

If you have questions about format review or deadlines please contact
The Office of Thesis and Dissertation Format Review
MSU Libraries
Office of Thesis & Dissertation Format Review
PO Box 5408, Mississippi State, MS 39762
Contact Information:
Phone (662) 325-2170    Email: etd@library.msstate.edu
Phone (662) 325-8756    Fax (662) 325-2895

Author’s Full Name (without abbreviations): _____________________________________________

MSU ID # (NOT your NetID or SSN): ___________________________________________________

Primary Phone #: ________________________ Secondary Phone #: _________________________

Current address: _________________________________________________________________

Permanent address: _______________________________________________________________

Permanent email address(es): ______________________________________________________

What are you submitting?    □ Thesis    □ Dissertation

NAME AUTHORITY INFORMATION
The Libraries create a Name Authority Record for authors to correctly identify their works in library catalogs around the world. Some require information such as a date of birth or a middle name. If you have questions about this section, please contact Bob Wolverton, Jr., Authority Control Librarian, at (662)325-4618.

Preferred Form of Name, if different from above: ___________________________________________

Previous names used (Maiden name, etc.): ________________________________________________

Date of Birth: ________________________

How do I look up my MSU ID?
1. Go to https://my.msstate.edu/rof/forms/displaylogin
2. Login using your net id / net password
3. Click on the BANNER tab
4. In the PERSONAL INFORMATION column — click on VIEW YOUR MSU ID NUMBER.
APPENDIX C
ETD RIGHTS AND PERMISSIONS FORM
The ETD Rights and Permissions Form is used to implement and track any desired restrictions (embargo) on the release of a submitted work. The author should confer with their committee on which option is best for the submitted work. The options are:

**Immediate Access:** The work will not be restricted and will be available for viewing by anyone after the semester of graduation.

**MSU Only:** The work is restricted to access only from the MSU campus or portals. The duration options are from 1 to 3 years or indefinite. This option is generally chosen by those who have pending publishing dates or departments that have future proprietary research based in whole or part of the submission.

**Patent/Proprietary:** The work is completely restricted with the only access available is through direct author contact. The duration for this restriction is 1 year. This option is generally chosen by those who have patents pending or include sensitive information.

In all cases, the title and abstract will be viewable. As such, titles and abstracts should not contain any sensitive information.

The publisher, UMI, uses the term “embargo” for their options for restriction. Restrictions selected on the publisher’s website must match or exceed the restrictions selected on the ETD Rights and Permissions Form. Durations selected on UMI are calculated from the date when the Office of Thesis and Dissertation Format Review (T/D) sends the final approval for all the current semester’s submissions, typically the following business day of the Final Submission Deadline. Authors may contact UMI to change the release date of their works at any time:

Contact **Author Relations** at **disspub@proquest.com** or **800.521.0600 ext. 77020**
For MSU, the duration is calculated by calendar year. Example: a work completed in Spring 2009 and restricted for 2 years would be subject to release in December 2011. Should an author desire to have MSU release their work earlier than is indicated, a new ETD Rights and Permissions Form will need to be submitted. In mid-November of a given year, T/D will attempt to email a notification to the author and the author’s major professor to proactively allow for the possibility of extending the restriction. Extending the duration of the restriction does not require a new ETD Rights and Permissions Form to be filed. Authors are responsible for contacting UMI (see above) to make any corresponding changes in release date.

Finally, the ETD Rights and Permissions Form requires both the author’s signature and the signature of the author’s major professor. If obtaining the major professor’s signature is not a viable option, then the department’s graduate coordinator’s signature will be allowed.

Special note: the form on the following page is not formatted uniformly with this document and purposefully does not have a page number. As such, it is not meant as an example of proper formatting in an appendix.
Mississippi State University
Electronic Thesis and Dissertation Rights and Permission

Student Name ________________________________

Student ID # ________________________________

Document Type: _____ Master’s Thesis _____ Educational Specialist’s Thesis _____ Doctoral Dissertation

Document Title: ______________________________

Student Agreement:

I hereby grant to Mississippi State University and its agents the non-exclusive license to archive and make accessible, under the conditions specified below, my above mentioned document, in whole or in part, in all forms of media, now or hereafter known. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use all or part of the above mentioned document in future works.

In addition to the unrestricted display of the bibliographic information and the abstract, I agree that the above mentioned document be placed in the ETD archive with the following status (choose one of 1, 2, or 3 by checking the appropriate space below)

_____ 1. Release the entire work immediately for access worldwide. This option strongly encouraged whenever appropriate.

_____ 2. Restrict the entire work to Mississippi State University and patrons of its libraries, including interlibrary sharing for a period of: 1 year _____ 2 years _____ 3 years _____ Indefinitely ____. During this restricted period, only those individuals with current MSU NetId’s or those using a computer with an MSU IP address can access these documents online. After the selected time has passed the ETD will be released worldwide.

   Why release to MSU only?
   • Publisher restrictions – some publishers will not publish works or parts of works previously published and/or widely disseminated.
   • Continuation of research – if the student plans to continue with the same line of research for immediate professional or educational purposes, he/she may prefer not to release worldwide but still allow access to the MSU community.

_____ 3. Secure the entire work for patent and/or proprietary purposes for a period of one year. During the period the copyright owner also agrees not to exercise her/his ownership rights, including public use in works, without prior authorization from Mississippi State University. At the end of the one year period, either I or Mississippi State University may request in writing an extension for one additional year by contacting the MSU Libraries Thesis and Dissertations Department at etd@library.msstate.edu or 662-325-2170. At the end of the one year secure period (or its extension, if such is requested), the ETD will be released worldwide.

Signed: ____________________________________ (Student) ______________________ (Date)

My signature below indicates that I have counseled the student regarding the appropriate access level for the electronic thesis/dissertation named above.

_______________________________________________ (Major Professor) ______________________ (Date)
GENERAL

Page Size and Margins (see 5.1.1)
___ All Theses and Dissertations should be on standard letter size pages (8.5” by 11”).
___ The required margins are: Top/Bottom: 1” Left/Right: 1.25”

Type Font and Print Quality (see 5.1.2)
___ Font size must be twelve points and a professional type.

Exceptions: Text inside tables and figures (not the titles) as well as notes for tables and figures may have any size text.

Superscripts and subscripts may use smaller text.

Equations may use any size text.

Footnotes and endnotes may use smaller text.

___ Symbols used in paragraphs must be actual font characters (when possible), not images inserted in the line.

___ Paragraphs may have text that is bold, italicized, underlined, in dark colors (on white background), or some combination of the previous and must be easily distinguishable from headings using similar formatting.

Paragraphs (see 5.1.4)
___ The left and indents of paragraphs must be 0”, i.e. the paragraph must align with the page margins. Lists and block quotes are exempt from this.

___ The first lines of all paragraphs must be indented consistently; the indent must be either 0.25” or 0.5”.

___ All paragraphs must be either left-aligned or fully justified, consistently. If a paragraph is fully justified, use line breaks to avoid awkward spaces in lines.

___ Paragraphs must be double-spaced (having only 1 blank line separating lines of text) and be separated from other paragraphs by 1 blank line. Excess space above or below a paragraph is not allowed unless otherwise stated in the Standards.

___ Do not leave only one line of a paragraph at the top or bottom of a page (unless the paragraph only has one line). In Word, this can be avoided by turning on the “Widow/Orphan Control” setting.
___ Symbols in paragraphs must be actual font characters (when possible), not images inserted in the line.

___ Scientific names and other discipline-specific terms may be formatted as required by the department. For example, scientific names may be italicized.

Pagination (see 5.1.5)

___ Every page must have a page number except the title page, copyright page, approval page, and abstract pages.

___ Small Roman numerals are used for the preliminary pages, which should be arranged in the following order: dedication; acknowledgements; table of contents; and the lists of tables, figures, plates, symbols, abbreviations, and/or nomenclature. Although the title page is assigned Roman numeral i, that number does not appear on the page. The copyright, approval, and abstract pages are neither counted nor numbered.

___ Arabic numerals are used for paginating the remainder of the document, including the text and reference material. Pages are numbered consecutively beginning with 1 and continuing to the end of the document.

___ All page numbers are placed at the bottom center position allowing 1 inch of white space from the numeral to the page bottom.

Excess Blank Space (see 5.1.7)

___ avoid any blank space not specifically required for the Standards. The following exceptions apply:

Moving a table or figure to the beginning of a new page to avoid splitting is allowed.

If excess space is caused by preventing a heading from sitting at the bottom of a page, it is allowed.

If only three or fewer lines of a paragraph fit below a table or figure, it is allowed if the author begins that paragraph on a new page.

Blank pages required by the department are allowed if a notification is added: “[This page left blank intentionally]”
Submission in PDF Format for Review (see 5.1.8)

_____ All submissions for review must be a single PDF file. (Do not scan documents as PDFs)

_____ Text must be selectable.

_____ Images should be actual image types (jpeg, ping, bitmap, etc) and not objects (such as drawing tools, sigma plots, etc.).

_____ All landscaped pages must be rotated into portrait pages.

_____ Fonts must be embedded to ensure cross platform fidelity of the text.

_____ The filename should not include any special characters or spaces.

PRELIMINARY PAGES

Title Page (see 5.2.1)

_____ No page number should appear on this page.

_____ All text on this page must be centered horizontally.

Note: The following describes the requirements from the bottom of the page to the top

_____ Include Month and Year of Graduation (not defense; see academic calendar) with no commas (for example, “August 2011”) directly above the bottom margin.

_____ The location must be written as “Mississippi State, Mississippi”, leaving only one blank line between the location and the graduation date below.

_____ The degree statement must be single-spaced, accurate as of the graduate date, and worded exactly as follows (including capitalization and line breaks):

A [Thesis|Dissertation]  
Submitted to the Faculty of  
Mississippi State University  
in Partial Fulfillment of the Requirements  
for the Degree of [Degree–Ask Department]  
in [Program or Concentration–Ask Department]  
in the [Department/College Awarding Degree–Ask Department]  

_____ Leave two or three blank lines between the degree statement and the location below.

_____ The author’s name must match that in MSU’s academic records.
____ Leave 1.5 inches (eight blank lines is close enough) between the author’s name and the degree statement below.

____ Leave one blank line between the word “By” (capitalized) and the author’s name below.

____ If the title is more than one line, it must be double-spaced and each line of the title shorter than the line above it.

____ The title must be not be in bold font. Capitalize only the first letter of the first word in the title and words normally capitalized in English (proper nouns, acronyms, etc.).

____ The title must not have equations or symbols (type out symbol names and equations). Exceptions may be allowed at the discretion of the Office of TD Review.

____ Leave 1 inch (five blank lines is close enough) between the title and the word “By” below.

Copyright Page (Optional) (see 5.2.2)

____ No page number should appear on this page.

____ All text on this page is centered horizontally and vertically.

____ The text must be double-spaced and must include the following:

- Copyright notice, e.g., “Copyright by” or “©”
- Author’s name, matching that on the title page.
- Year of graduation

Approval Page(see 5.2.3)

____ The title is placed just below the top margin. Format and wording of the title must exactly match the title on the title page.

____ There must be 2 or 3 blank lines between the title and the word “By” below.

____ The word “By” is centered on its own line, then followed by one blank line and the author’s name (centered and matching the name on the title page).

____ The author’s name is followed by one blank line, then the word “Approved:” is left-aligned.

____ Below “Approved:” are placed one centered column of signature lines.
Lines are required for:

- the thesis/dissertation director(s)
- the committee members
- the graduate coordinator (if not already serving as a committee member/director)
- the dean of the college granting the degree

Each signature line requires (the following must be single-spaced and left-aligned with the left edge of the signature line):

- Enough space above the line for a signature
- The individual’s name without honorifics (like “Dr.”) or degree designations (like “Ph.D.”). This must match the name found on the Office of the Graduate School's page: List of Graduate Faculty Members by Last Name
- In parentheses, the role(s) of the individual, for example, “(Dissertation Director)” or “(Graduate Coordinator)” or “(Committee Member)”. If your graduate coordinator also serves on your committee, then add "/Graduate Coordinator" after the committee role. NOTE: The Dean’s title is his or her role; do not have anything in parentheses.

Signature lines are ordered top to bottom. The first signature line must be the Thesis/Dissertation Director(s), followed by committee members, then the graduate coordinator, and finally the dean.

All of this must fit on one page. There is no page number on this page.

If there is not enough space to fit all of the signature entries on one page in the center column, then the first two entries may be placed side by side, in a double column, with the required content centered within the column. This may be repeated as many times as necessary to minimally fit all the required entries on a single page.

Note, if a committee member fulfills multiple roles (example: Director of Dissertation and Graduate Coordinator), then each role should be listed under a single entry, that is, do not list the same individual twice-just add an additional line with the extra role.
Abstract (see 5.2.4)

There are no page numbers on these pages.

Starting at the top of the page, the following entries must all be included. Each entry is single-spaced with a blank line following.

- **Name:** followed by the author’s name as found on the title page.

- **“Date of Degree:”** followed by the date of graduation formatted as “Month Day, Year”. For example, “August 9, 2011”

- **“Institution: Mississippi State University”**

- **“Major Field:”** followed by the program/concentration as found on the title page.

- **“Major Professor:”** followed by the major professor’s name. If there are co-major professors, then the second professor’s name follows immediately after the first with a comma separating.

- **(If the dissertation director is not the major professor) “Dissertation Director:”** followed by the dissertation director’s name. If there are co-directors, then the second director’s name follows immediately after the first with a comma separating.

- **“Title of Study:”** followed by the title as worded on the title page.

- **“Pages of Study:”** followed by the page number of the last numbered page of the document. This is counting the appendices.

- **“Candidate for the Degree of”** followed by the degree as found in the title page.

If the entry is more than one line long (this is likely to happen only with the title), the second and following lines of the entry must be aligned with the first word after the entry colon. For example:

**Title of Study:** The use of neural networks in the combining of time series forecasts with differential penalty costs

The “Candidate for...” entry is followed by 2 or 3 blank lines, then the abstract body.

The abstract body must not have equations, symbols (type out symbol names and equations), bullets, figures, and tables. Exceptions may be allowed at the discretion of the Office of TD Review.
The maximum size of a thesis’s abstract body is 150 words. The maximum size of a dissertation’s abstract body is 350 words.

If the discipline requires key words, 2 or 3 blank lines are left between the abstract body and the key words. The key words are single-spaced and indented like an abstract entry. They are written “Key words:” followed by a comma-separated list of key words.

The page after the last page of the abstract is page “ii”.

Dedication (Optional) (see 5.2.5)

There must be 2” of blank space between the top of the first page of the Dedication and the top of “DEDICATION”.

“DEDICATION” must be centered, in all caps, and not bold.

Keep 2 or 3 blank lines between “DEDICATION” and the first line of the Dedication text.

If the Dedication has not been omitted, the first of the Dedication is page “ii” (lower-case Roman numeral)

Acknowledgements (Optional) (see 5.2.6)

There must be 2” of blank space between the top of the first page of the Acknowledgements and the top of “ACKNOWLEDGEMENTS”.

“ACKNOWLEDGEMENTS” must be centered, in all caps, and not bold.

Keep 2 or 3 blank lines between “ACKNOWLEDGEMENTS” and the first line of the Acknowledgements text.

The Acknowledgements text must be in paragraphs formatted as described in the “GENERAL” section.

Table of Contents (see 5.2.7)

There must be 2” of blank space between the top of the first page of the Table of Contents and the top of “TABLE OF CONTENTS”.

“TABLE OF CONTENTS” must be centered, in all caps, and not bold.

Keep 2 or 3 blank lines between “TABLE OF CONTENTS” and the first entry of the Table of Contents.

113
___ All entries should have a dot leader extending from the last word of the entry title to the entry page number (which is right-aligned with the right margin). In Word, this should be done with a right tab stop at 6” with leader style 2 (do NOT use periods).

___ The right edge all lines of the entry title cannot extend past the left edge of the entry page number. In Word, a right indent of 0.5” will ensure this.

___ All entries of the same level must align with each other. For example, all chapter entries are of the same level; thus, their chapter numbers must align with each other and the first words of their titles must align. Similarly, all entries for headings must align with the other entries for headings of the same level.

___ Capitalization and spelling of all entries must match that of the entire corresponding item. In Word, copy and paste will ensure this.

___ Entries must be normal text save for discipline-specific formatting, e.g., italicizing scientific names, bolded chemical numbers. NOTE: Superscripts and subscripts must be preserved.

**For documents with un-numbered headings:**

___ Any lines of the entry title after the first are indented 0.5” to the right of the first letter of the entry title (not the chapter number).

___ First-level-heading entries are aligned with the titles of chapter entries.

___ Lower-level-heading entries are aligned 0.25” to the right of the entries one level higher, e.g. second-level entries are 0.25” to the right of first-level entries, and third-level entries are 0.25” to the right of second-level entries.

**For documents with numbered headings:**

___ Any lines of the entry title after the first are aligned with the first letter of the entry title (not the chapter or section number). This is called “block alignment”

___ First-level-heading entries consist of:

- A section number, left-aligned with the first letter of the chapter entry titles.

- A section title. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”
Lower-level heading entries are aligned 0.25” to the right of the entries one level higher, e.g. second-level entries are 0.25” to the right of first-level entries, and third-level entries are 0.25” to the right of second-level entries. NOTE: As section numbers get longer at lower levels, those section titles will move more than 0.25” to the right of the previous level’s titles. Keep these titles aligned with other titles of the same level.

There must be preliminary section entries for (if these sections are in your document) the Dedication, Acknowledgements, List of Tables, List of Figures, and any additional preliminary sections placed after the List of Figures. No entry is added for the Table of Contents.

Preliminary section entries must be fully left aligned and single-spaced with one blank line below them.

After the blank line following the last preliminary section entry, add the word “CHAPTER” (all caps, normal text, left-aligned, no dot leader or page number following) with one blank line below it, followed by the entry for Chapter I.

Chapter entries consist of

- The chapter number (in Roman numerals or Arabic, depending on the format in the body) followed by a decimal point. The decimal must be aligned under the “P” in the word “CHAPTER” above Chapter I’s entry. In Word, this is measured 0.43” from the left margin.

- The chapter title, single-spaced. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”

- One blank line between the chapter entry and the next entry.

Section entries are single-spaced, with no blank lines below them (unless it is the last entry in the chapter, in which case one blank line is placed between it and the following entry).

If bibliographic sections are placed at the end of each chapter, then the reference section entries are formatted as first-level-heading entries. If there is one (or more) bibliographic section for the entire document, then the corresponding entry is formatted like that of a preliminary section (including the one blank line following).
For documents with one or more appendices:

___ Appendix entries are placed at the end of the Table of Contents

___ Add the word “APPENDIX” (all caps, normal text, left-aligned, no dot leader or page number following) with one blank line below it, followed by the entry for Appendix A.

___ Appendix entries are formatted the same as chapter entries, save that the chapter number is replaced by an appendix letter.

___ Section entries in the appendices are formatting the same as section entries in the body.

List of Tables (see 5.2.8)

___ There must be 2” of blank space between the top of the first page of the List of Tables and the top of “LIST OF TABLES”.

___ “LIST OF TABLES” must be centered, in all caps, and not bold.

___ Keep 2 or 3 blank lines between “LIST OF TABLES” and the first entry of the List of Tables.

___ All entries should have a dot leader extending from the last word of the entry title to the entry page number (which is right-aligned with the right margin). In Word, this should be done with a right tab stop at 6” with leader style 2 (do NOT use periods).

___ The right edge all lines of the entry title cannot extend past the left edge of the entry page number. In Word, a right indent of 0.5” will ensure this.

___ Capitalization and spelling of all entries must match that of the entire corresponding item. In Word, copy and paste will ensure this.

___ Entries must be normal text save for discipline-specific formatting, e.g., italicizing scientific names, bolded chemical numbers. NOTE: Superscripts and subscripts must be preserved.
Each table entry is single-spaced and consists of:

- The table number. If tables are numbered sequentially, the entry numbers are right aligned with each other. If tables are numbered by chapter/appendix, the entry numbers are aligned by the period in the middle of the number.

- The table title. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”

- One blank line between this entry and the next one

For documents with un-numbered headings in the Table of Contents:

- Any lines of the entry title after the first are indented 0.5” to the right of the first letter of the entry title (not the entry number).

For documents with numbered headings in the Table of Contents:

- Entry titles are block aligned.

**List of Figures (see 5.2.9)**

- There must be 2” of blank space between the top of the first page of the List of Figures and the top of “LIST OF FIGURES”.

- “LIST OF FIGURES” must be centered, in all caps, and not bold.

- Keep 2 or 3 blank lines between “LIST OF FIGURES” and the first entry of the List of Figures.

- All entries should have a dot leader extending from the last word of the entry title to the entry page number (which is right-aligned with the right margin). In Word, this should be done with a right tab stop at 6” with leader style 2 (do NOT use periods).

- The right edge all lines of the entry title cannot extend past the left edge of the entry page number. In Word, a right indent of 0.5” will ensure this.

- Capitalization and spelling of all entries must match that of the entire corresponding item. In Word, copy and paste will ensure this.

- Entries must be normal text save for discipline-specific formatting, e.g., italicizing scientific names, bolded chemical numbers. NOTE: Superscripts and subscripts must be preserved.
Each figure entry is single-spaced and consists of:

- The figure number. If figures are numbered sequentially, the entry numbers are right aligned with each other. If figures are numbered by chapter/appendix, the entry numbers are aligned by the period in the middle of the number.

- The figure title. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”

- One blank line between this entry and the next one

For documents with un-numbered headings in the Table of Contents:

- Any lines of the entry title after the first are indented 0.5” to the right of the first letter of the entry title (not the entry number).

For documents with numbered headings in the Table of Contents:

- Entry titles are block aligned.

**List of Symbols, Abbreviations, Special Nomenclature, and Other Preliminary Pages (see 5.2.10)**

- There must be 2” of blank space between the top of the first page of the preliminary section and its title.

- The title must be centered, in all caps, and not bold.

- Keep 2 or 3 blank lines between the title and the rest of the preliminary section.

- Keep the vertical alignment of entries within this section consistent.

- If the entries consist of item numbers followed by items titles, follow the same rules as the List of Tables and List of Figures.

**MAIN BODY**

**First Page of Each Chapter (see 5.3.1)**

- There must be 2” of blank space between the top of the first page of the chapter and the top of the word “CHAPTER” and the chapter number.

- The word “CHAPTER” is followed by one space and the chapter number. The chapter number may be a Roman numeral (preferred) or an Arabic numeral, but must be the same style for all chapters.
The word “CHAPTER” and the chapter number must be centered, in all caps, and not bold.

Leave one blank line between the word “CHAPTER” and the chapter title.

The chapter title must be centered, in all caps, and not bold. If the title is more than one line, it must be double-spaced and each line of the title shorter than the line above it.

Leave two or three blank lines below the chapter title.

The first page of chapter I must be numbered “1”.

**Headings (see 5.3.2)**

There must be one blank line between a heading and the paragraph below.

All headings must have 2 or 3 blank lines above them. The only exception: If a heading is followed by another heading, you may have one blank line between them. If you take this exception, be consistent.

Do not place punctuation at the end of a heading.

Do not leave a heading at the bottom of a page; such headings should be moved to the top of the next page. In Word, this is fixed by turning on the “Keep with next” option in the paragraph settings for each heading.

If sections are numbered:

- Section numbers must align with the left margin.

- Numbers must be Arabic and start with the chapter number followed by a decimal and then the current heading number. For lower level headings include the previous heading number and add a decimal and start the new level numbering.

- Headings (including section numbers) are bold and block aligned.
If sections are not numbered:

- Each level of heading has its own unique, consistent formatting. For example, all first-level headings are formatted the same. All second-level headings are formatted the same, and this formatting must be different than that of the first-level headings, and so on.

- Headings are left- or center-aligned (no indents) and are formatted with any combination of the following: bold, italic, underlined. Do not use normal text for a heading. Do not use all caps or small caps for a heading.

- If you use italicized terms (like scientific names) in your headings, do not use italics for any level of heading formatting. The same goes for bold terms and bold headings. Exceptions may be allowed at the discretion of the Office of TD Review.

- Multiple line headings must be single or double-spaced. If such headings are centered, they each subsequent line must be short than the previous line.

Tables (see 5.3.5)

- Tables may not be placed in the middle of a paragraph, even if the paragraph is split between two pages.

- The table title must have 2 or 3 blank lines above it.

- Do not place table titles in a row of the table.

- Choose one of the two styles of table title:

  - Centered style: The word “Table”, one space, and the table number, centered. Below that, one blank line, then the table title, single-spaced, centered, with every line smaller than the line above. Below that, one blank line, then the table itself, centered.

  - Block style: The word “Table”, one space, then the table number, aligned with the left margin. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”. Then, the table title, single-spaced and block aligned. Below that, a blank line, then the table, left-aligned or centered (be consistent for all tables).

- Table numbering must be consistent within the entire document and either numbered sequentially or by chapter. Note: If headings are numbered by chapter then tables must also be numbered by chapter.
The table itself is formatted according to the author’s need. Any size font, any style text is allowed, as long as the table is legible and meets departmental standards.

The table gridlines may not extend into the margins. Word tends to get this wrong automatically. Setting the cell margins to 0” will fix this.

Table must be in line with text (no text wrapping).

Notes go below the table (not inside it). There may be zero or one blank line separating table from notes.

Keep two or three blank lines below the table (or the notes, if present).

If a table is more than one page in size (note: if a table can be placed on one page, it must be. Do not break small tables over two pages), then the table title is placed above the first page. Above the following pages of the table, place the word “Table”, a space, the table number, a space, then “(continued)”, followed by one blank line, then the piece of table for that page. Notes for a table appear below the last part of the table.

Figures (see 5.3.6)

Figures may not be placed in the middle of a paragraph, even if the paragraph is split between two pages.

The figure must have 2 or 3 blank lines above it.

Do not place figure titles in the figure itself or a text box.

Figures should be inserted as images. If the Office of TD Review sees that a figure is slow in rendering, they will require the figure be replaced with an image.

Choose one of the two styles of figure title:

- Centered style: Below the centered figure, one blank line, then the word “Figure”, one space, and the figure number, centered. Below that, one blank line, then the figure title, single-spaced, centered, with every line smaller than the line above.

- Block style: Below the figure (centered or left-aligned, be consistent), one blank line, then the word “Figure”, one space, then the figure number, aligned with the left margin. The space separating the number from the title should be enough to distinguish the two, but not exceeding 0.5”. Then, the figure title, single-spaced and block aligned.
____ Figure numbering must be consistent within the entire document and either numbered sequentially or by chapter. Note: If headings are numbered by chapter then figures must also be numbered by chapter.

____ The figure itself is formatted according to the author’s need as long as it is legible and meets departmental standards.

____ If the figure has white space at the top or bottom of the image itself, it must be cropped or surrounded with a single-line border, i.e., no shadows, 3-D, etc.

____ Figures may not extend into the margins

____ Figures must be inserted in line with text (no text wrapping).

____ Notes go below the figure title (not inside it). There must be one blank line separating figure title from notes.

____ Keep two or three blank lines below the figure title (or the notes, if present).

____ If a figure is more than one page in size (note: if a figure can be placed on one page, it must be. Do not break small figures over two pages), then the figure title is placed below the figure portion on the first page. Below the figure portions on the following pages, add a blank line, then place the word “Figure”, a space, the figure number, a space, then “(continued)”. Notes for a figure appear below the last “(continued)” note.

____ Multiple small figures that are related may be grouped together provided that:

- each figure contains an identifier (“a”, “b”, “c”, or equivalent identifier) inside each image.

- the group of figures is given only 1 collective title

- notes for the figure detail the specifics by referencing the unique labels for each figure.

Landscape Pages (see 5.3.7)

____ In the PDF submission, all landscape pages must be rotated to a portrait orientation. All margin considerations and page number location must conform to the final rotated page layout. Simply, after the landscaped page is rotated in the .pdf, it should be indistinguishable from all other portrait pages.

____ The tops of text and images on a landscape page should be oriented to the left once rotated.

Equations (see 5.3.8)
____ All equations outside of a paragraph must be numbered in the same method as the tables and figures.

____ Equation numbers must be aligned with the right margin.

____ Consistent spacing must be kept above and below equations.

____ Equations must be aligned in one of two ways: Centered horizontally on the page, or consistently left-aligned with all other equations.

____ If there are a series of equations for one equation number, the equation must be aligned by the equivalency sign or other major operator, e.g., less-than sign.

____ Verify the proper output of the equations in the PDF. It may be beneficial to convert equations to images.

**Bibliographic Materials (see 5.3.9)**

For bibliographic sections placed at the end of each chapter:

____ Start a new page.

____ Format the section heading as a first-level subheading (do not use all caps), followed by one blank line, then the first bibliographic entry.

For an overall bibliographic section at the end of the document:

____ Start a new page.

____ There must be 2” of blank space between the top of the first page of the section and the top of the section title.

____ The section title must be centered, in all caps, and not bold.

____ Keep 2 or 3 blank lines between the section and the first bibliographic entry.

For all bibliographic sections:

____ Bibliographic entries must be single-spaced with a blank line below each entry. All other formatting is to be according to departmental citation standards.

____ Entries should not be split across a page break.
Appendices (see 5.4)

Appendices are lettered A, B, C, etc. If there is only one appendix, it is Appendix A.

Every appendix is preceded by a divider page, which has the following text centered vertically and horizontally on the page:

- The word “APPENDIX”, a space, then the appendix letter
- one blank line
- The appendix title, double-spaced, in all caps, with each line smaller than the line above.

If the appendix is divided into sections, the section headings must match the format of the headings in the body.
APPENDIX E

OTHER RESOURCES
E.1 Workshops

The Library offers many workshops to assist in the learning of various software applications and research. These workshops are offered as a free service to Students and Faculty. Space for a given workshop may be limited, so please be sure to register in the calendar of events for the workshops that you plan to attend.

E.2 Instructional Media Center

The Instructional Media Center (IMC) is available to assist with one-on-one support of any of the software packages offered in the multimedia lab, including the use of Microsoft Office, EndNote, and Adobe Professional. Please call to schedule appointments for individual training.

E.3 Library Instructional Services Department

The Library Instructional Services Department provides information on how to best utilize the library and the library databases for research. They also provide the Survival Skills for Graduate Student to help beginning researchers refine their path toward successful scholarly research.

E.4 The Writing Center

The Writing Center provides support for grammatical and general organizational presentation of content to facilitate effective communication of an author’s ideas. This service is available to all MSU students by the Department of English.