

AN M.S. THESIS OR PH.D. DISSERTATION EXTENDED ILLUSTRATION SAMPLE
GENERATED - USING THE NEW "NDSU-THESIS-2022" L^AT_EX CLASS AND
TEMPLATE

A Dissertation
Submitted to the Graduate Faculty
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By

Samuel Quincy Student

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Title

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The Supervisory Committee certifies that this dissertation complies with North Dakota State University's regulations and meets the accepted standards for the degree of

DOCTOR OF PHILOSOPHY

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ABSTRACT

Note: All the sample text from the example thesis and dummy text are in black and other instructions by the author are shown in color to draw users' attention. It should be noted that for the NDSU actual thesis/dissertation only black text should be used in general!

This is the abstract for my thesis.

This document uses the new: `nds-thesis-2022.cls` class and `my-bib-file.bib` file storing the bibliography database. NDSU has word count limitations and that should be adhered to. URL: https://www.ndsu.edu/gradschool/current_students/graduation/theses_dissertations_papers/disquisition_formatting: “Margins must be at least 1 in on each side of the page. Page number margins must be at least 0.75 in from the bottom of the page. Abstracts appear after the Disquisition Approval page and begin on page iii of the disquisition. Abstracts for dissertations may not exceed 350 words. Abstracts for thesis and papers may not exceed 150 words.”

One the useful resources to learn \LaTeX is: https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes?utm_source=overleaf&utm_medium=email&utm_campaign=onboarding And others include (details in REFERENCES): (1) The Not So Short Introduction to $\text{\LaTeX} 2_{\epsilon}$, (2) A Guide to \LaTeX and Electronic Publishing, and (3) \LaTeX – A Document Preparation System.

Several features such as `newcommand` - shortcuts, `longtable` - spanning more pages, `threeparttable` - table notes, tables spanning the entire width (`tabu`), `subfigures` - side-by-side figures, `tikz` - code-generated vector figures, `itemize` - bullet list, `enumerate` - number list, `matrix`, advanced math, various symbols, etc., can be inserted into the thesis following standard resource materials. All the general \LaTeX based commands and features will work in the NDSU \LaTeX thesis class.

— C. Igathinathane

Ag & Bio Sys Eng, NDSU

ACKNOWLEDGEMENTS

I acknowledge people here.

DEDICATION

This thesis is dedicated to my cat, Mr. Fluffles.

PREFACE

You can put a preface here.

TABLE OF CONTENTS

ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
DEDICATION	v
PREFACE	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
LIST OF SYMBOLS	xiii
LIST OF APPENDIX TABLES	xiv
LIST OF APPENDIX FIGURES	xv
1. GENERAL ASPECTS — PAPER-STYLED CHAPTER — SOME STUDY TITLES ARE LONG, AND WE ARE MAKING IT LONG ENOUGH SO THAT IT FLOW MORE THAN TWO LINE - OOPS IT WENT TO THE FOURTH	1
1.1. Abstract	1
1.2. Introduction — Second Section After Abstract — \LaTeX as a Tool for Students/Researchers	2
1.2.1. Using and Installing \LaTeX — Online and Desktop Environments	2
1.3. Merits and Issues of Using \LaTeX	3
1.3.1. Advantages	3
1.3.2. Possible Issues — And Our Takes	9
1.3.3. Useful \LaTeX Resources — Subsection (titlecase)	11
1.3.4. Modern \LaTeX Commands - Calculations	11
1.4. Some New Helpful Commands and Options Available in NDSU Thesis Class	12
1.4.1. Introduction Subsection	15
2. TABLES IN THESIS/DISSERTATION — REGULAR-STYLED CHAPTER	17

2.1.	Simple Tables	17
2.2.	Help with L ^A T _E X Tables	18
2.3.	Full-width Tables	19
2.3.1.	Manual Method — Using Table Column Width	19
2.3.2.	Automatic Method — Using <code>tabu</code> Environment — Equal Widths	21
2.3.3.	Automatic Method — Using <code>tabu</code> Environment — Unequal Widths	21
2.3.4.	Another Example with Multicolumn and <code>Cmidrule</code>	23
2.4.	Landscape Tables	25
2.5.	Long Tables	27
3.	FIGURES IN THESIS/DISSERTATION	31
3.1.	Figures in the Chapters	31
3.2.	Shortcut Commands for Figures in Class	31
3.2.1.	Figure Shortcut Command — 5 Arguments	31
3.2.2.	Figure Shortcut Command — 1 Optional + 5 Arguments	32
3.3.	Landscape Figures	33
3.4.	Subfigures with Automated Numbering	36
3.5.	Subfigures Spanning Multiple Pages	37
4.	CROSS REFERENCE IN DISQUISITION	40
4.1.	Clever Way of Referencing Labels Using <code>cleveref</code> Package	40
4.2.	Customizing <code>Cleveref</code> Commands	40
5.	BIBLIOGRAPHY CITATION	42
5.1.	Citing References Through <code>natbib</code> Package	42
5.2.	Author-year and Numbered Citations of <code>natbib</code>	43
5.3.	Using <code>BibL^AT_EX</code> for Citation	44
6.	OTHER ASPECTS IN DISQUISITION - PAPER-STYLED CHAPTER	45
6.1.	SI units in thesis/dissertation	45
6.2.	Handling Equations	45
6.3.	Spacing adjustment around non-textual elements	46

6.4. Annotation Commands	48
6.5. Handling URLs	48
6.6. Theorems Environment	49
6.7. Fun Notes	51
7. SEVENTH CHAPTER WITHOUT TABLES AND FIGURES	52
7.1. Test 1	52
7.1.1. Test 2	52
REFERENCES	53
APPENDIX	56
A.1. Appendix Figure	57
A.1.1. One of One	58
A.1.2. Two of One	59
APPENDIX A. NAMED APPENDIX TITLE HERE	60
A.1. Section Test	60
A.2. Another Section	61
A.2.1. Test 2	62
APPENDIX B. NAMED SECOND APPENDIX TITLE HERE	63
B.1. Test	63
B.2. Normal Section	65
APPENDIX C. THIRD APPENDIX TITLE HERE	66
C.1. Test1 and Program Source Code Listing	66
C.1.1. Test2	67

LIST OF TABLES

Table	Page
2.1. Simple fixed-width table with left-justified top caption.	17
2.2. Professional looking fixed-width table with left-justified top caption using <code>booktabs</code> package.	18
2.3. Professional looking full-width table using <code>\tabcolsep</code> and <code>booktabs</code> package. .	20
2.4. Professional looking full-width table using <code>\tabcolsep</code> , <code>@{...}</code> , and <code>booktabs</code> package.	20
2.5. Professional looking automatic full-width table using <code>tabu</code> environment and <code>booktabs</code> package.	21
2.6. Full-width table using the <code>tabu</code> environment showing some vegetative indices formulas demonstrating the use of <code>X</code> column code with variable column widths and <code>math</code> column specifications (<code>X[0.8, \$]</code>).	22
2.7. Full-width table using the manual method showing some vegetative indices formulas — Reproduction of table 2.6.	24
2.8. Manual method full-length table showing multicolumn and rule.	25
2.9. Automatic method full-length table showing multicolumn and rule.	25
2.10. Landscape table uses <code>landscape</code> environment from <code>pdfscape</code> package (loaded in the class). Landscape tables are set in a separate page using <code>[p]</code> and usually don't have surrounding text, which makes sense. With the <code>p</code> specifier the table is also centered vertically, otherwise with <code>h</code> and <code>t</code> will start from the top, and <code>\vspace*</code> command need to be used to bring it down. The <code>\columnwidth</code> in the landscape mode is = 8.74999995 in. Note this table was resized using <code>\resizebox</code> command — Check the source code for details.	26
2.11. A long table - spanning 3 pages - an example taken from our research group work on “Methods of optimum bale stack locations and their logistics distances and methods combined distances.”	27

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
3.1. This frog figure short caption is centered - NDSU.	31
3.2. Figure short caption is centered. Use of <code>\myfig{}</code> command.	32
3.3. Figure with a long caption where it is left-justified. More text text text text text text text text used to make the title long.	32
3.4. Caption this frog was uploaded via the file-tree menu - a long title long title long title long title long title long title long title long title long title.	33
3.5. Landscape figure with long long long long long long long long long long long long long long long long long caption and vertical caption placement using 5mm.	35
3.6. General caption of the subfigure - all the captions and sub-labels were created through <code>\subfloat[...]{...}</code> command of <code>subfig</code> package.	36
3.7. Multiple page sub-figures — General caption of the subfigure - all the captions and sub-labels were created through <code>\subfloat[...]{...}</code> command of <code>subfig</code> package.	37

LIST OF ABBREVIATIONS

AC	Alternating Current
AGL.....	Above Ground Level
API	Application Programming Interface
NDSU.....	North Dakota State University
ZL.....	Zeta Level

LIST OF SYMBOLS

A	Area (m^2)
e	Euler's constant (2.718 281 828)
R^2	Coefficient of determination
T	Time (s)
v	Velocity (m s^{-1})
x	x -coordinate of image pixel
y	y -coordinate of image pixel
σ	Standard deviation
γ	Hyperparameter in SVM

LIST OF APPENDIX TABLES

<u>Table</u>	<u>Page</u>
A1. One appendix full-width table captions go at the top of the table.	59
A1. Appendix table (full-width) using <code>tabu</code> package with <code>booktabs</code> commands illustrating column width coefficient (2nd column is thrice the width of 1st) and automatic overflow of rows as a paragraph. Captions go at the top of the table and left-justified.	61
B1. Named appendix B full-width table ONE using <code>tabu</code> environment.	63
B2. Named appendix B full-width table TWO using <code>tabu</code> environment.	63

1. GENERAL ASPECTS — PAPER-STYLED CHAPTER — SOME STUDY TITLES ARE LONG, AND WE ARE MAKING IT LONG ENOUGH SO THAT IT FLOW MORE THAN TWO LINE - OOPS IT WENT TO THE FOURTH*

1.1. Abstract

Welcome to the L^AT_EX “`nds-thesis-2022`” document class (NDSU class hereafter) and this document serve as an *extended example* of a template. The users are urged to first get familiarized with the *NDSU class documentation*, where most of the instructions for developing the thesis/dissertation using the NDSU class are clearly outlined. The NDSU class tries to address several dissertation requirements that graduate students come to expect from a template. While L^AT_EX provides several tools to create a professional-looking document, it requires some learning — a new set of skills is always a desirable thing to have, especially for students. Several leading universities have their *thesis* class and template to help their students, and NDSU is no different (we do have our thesis class, and being used by several students!). The NDSU L^AT_EX class (previous and updated) even features in the CTAN (Comprehensive T_EX Archive Network) repository of L^AT_EX. CTAN is the central archive location that currently (July 2022) has 6249 packages from 2869 contributors and most of the packages are free to download and use immediately. A search on “thesis” returns 114 hits in CTAN showing the popularity of universities developing their L^AT_EX class to help their grad students with dissertations. Given the quality of output, no wonder that several publishing houses (peer-reviewed journals and books) use L^AT_EX as their system and provide

*This paper is planned to be submitted as a review article in the *Advanced Technical Research Collection* journal. All the co-authors have assisted in the research direction and review of the manuscript.

authors with templates and reference styles. In this document/chapter, we outline and provide illustrations of using the updated NDSU class for developing thesis/dissertations, and users should have noted that this document itself uses the updated NDSU class.

1.2. Introduction — Second Section After Abstract — L^AT_EX as a Tool for Students/Researchers

Students having some exposure to computer programming, which is quite common nowadays, find their way easily with L^AT_EX as it follows structure principles (e.g., HTML, program codes requiring open and end braces/brackets, etc.). It is interesting to hear what the creator of L^AT_EX says on this:

L^AT_EX is easy to use — if you're one of the 2% of the population who thinks logically and can read an instruction manual. The other 98% of the population would find it very hard or impossible to use. — Leslie Lamport (2001)

As mentioned in the class documentation, it is safe to assume that students of higher education that came this far should have “cared enough” to improve the quality of their thesis/dissertation. On the other hand, some who may think they fall in the 98% might discover that they have better logical skills than they originally believed. Based on our personal experience, L^AT_EX is not as difficult as it was portrayed, and the benefits outweigh the effort (which also is a great skill to be acquired). Furthermore, using L^AT_EX for the documentation needs (e.g., thesis/dissertation, paper, report, book, letter, CV, and so on) should be considered a useful skill in itself that students can pick up and use throughout their carrier.

1.2.1. Using and Installing L^AT_EX — Online and Desktop Environments

This text was reproduced from the NDSU class documentation (Sec. 2) for ready reference. Several online (e.g., Overleaf, Kile LaTeX Editor, Authorea, Paperia, and so on)

and standalone desktop versions (e.g., TeXMaker, TeXWorks, TexShop, TeXStudio, and so on) of L^AT_EX editors are available. Online editors are “ready-to-go,” with several templates, tutorials, and help documentation, where the user need not install the software but require an internet connection. The desktop version requires software installation and updating (not very frequent). Resources (text and video instructions) are available on both how to use the online editor and install the L^AT_EX desktop version of users’ choice. As L^AT_EX is open source, most of these editors are free.

1.3. Merits and Issues of Using L^AT_EX

The advantages and the possible issues of using L^AT_EX as the system especially for preparing articles, thesis, and books from the viewpoint of ABE students and professionals, both beginners and advanced users, are listed and discussed.

1.3.1. Advantages

- L^AT_EX is a open source, free yet advanced, software that can be readily downloaded and installed easily in every type of computing system (Windows, Linux, Unix, DOS, and Mac OS). L^AT_EX is also a system that grows benefiting from the user-developed codes (classes, packages, and templates), and all these updates are again open source and free to use.
- L^AT_EX allows the user to concentrate on the content while L^AT_EX performs the consistent formatting. In other words, the author does the “writing” and the L^AT_EX compiler performs the consistent “formatting.” — In text processing systems (TPS), without a template different users will produce different outputs that lack consistency, but using a L^AT_EX class file, an essential argument of ‘documentclass,’ ensures consistency across users.
- L^AT_EX packs in the sound principles of professional typesetting while formatting the documents. This introduces the concept of “readability” of documents that takes care of

features like the number of words per line, their spacing, hyphenation, spacing of elements with reference to font size, ligature, etc. — Authors, in general, may not be aware of these principles of typesetting, and they go by “visual formatting” to their personal preference, sometimes violating the principles of typesetting, resulting in documents that lack consistency across authors, while \LaTeX does the “logical formatting” that is well suited for technical documents.

- \LaTeX automates and updates several aspects of the document such as, table of contents (short and extended), list of tables, list of figures, index (multi-level), bibliography, nomenclature, glossary, among several other features. As \LaTeX forces the users to follow the “structural” principles, automation of these features was possible and fully realized. — Although such automation was possible with other TPS, the users are mostly unaware or rarely use them. Hence, this opportunity is usually *missed* with TPS, but the benefits come naturally with \LaTeX as it is a “structural” language.
- \LaTeX is an excellent choice of a document preparation system for technical theses, reports, and books. For thesis, some of the universities have developed their \LaTeX document class and template files, and when utilized will create a uniform feel for all the thesis prepared. — This uniform style among thesis is possible with other TPS as well through templates, yet the other automation benefits are not quite common with TPS.
- Moving document elements while revising the document that calls for updating the numbers of the cited elements (headings, equations, floats, table of contents, index, etc.) will be handled automatically. — This in the traditional manual way will be tedious and highly error-prone.

- The user can have all the references in one place as a BibTeX (*.bib) flat-file that can have several hundred entries, yet being ASCII the size will be quite small. For example, for a 100 article entry, with 1757 lines of data, the size of the bib file is 68 KB, as opposed to the same content in the TPS doc file is 192 KB. Such master bib file will serve as “Once Write and Read Many” mode of operation and can be subjected to several style formats directly. — Usually, such automation with TPS may require additional commercial software (e.g., EndNote).
- The references will be automatically generated with proper format when appropriate style files were used. This avoids the classical error of *uncited references* and *unlisted references*, which eliminates the need for the reviewer to check for this unproductive and easily avoidable mistake from the authors. With some styles (e.g., `chicagoa.bst`) the reference items get sorted alphabetically. — This is a clear advantage over other manual document preparation systems.
- L^AT_EX measurements are very accurate and the smallest dimension it can recognize is ‘sp’ (scaled point) and 65536 sp make 1 pt that in turn $\approx 0.351366666666667$ mm (Wikibook Contributors, 2016). Therefore the smallest dimension that is available in L^AT_EX for manipulating elements (e.g., moving and sizing) is approximately $\frac{1}{186517}$ mm = 0.00536 μ m. — Such fine tuning of elements is unheard of with TPS in general.
- Users can generate the submission-ready double-spaced “review” as well as two-column, double-sided, single-spaced “final” formats of the paper from the same source by utilizing appropriate options in the document class (e.g., `elsarticle.cls`). — Usually, with TPS the user has to create two different versions manually.

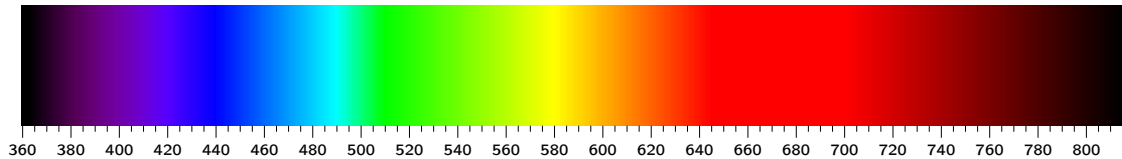
- It is possible to submit the rendered pdf version of the paper (`*.pdf`) directly to the publishers (e.g., Elsevier Editorial System - EES) and after acceptance, the source code files (`*.tex`) can be uploaded. This method subsequently allows for direct usage of the codes by the publishers during proofs production, without having to re-key or convert articles submitted using other TPS. — Hence the usage of \LaTeX results in quicker production and fewer errors in typesetting.
- Journal articles that are camera-ready, professionally typeset, journal-feel, compact (usually ≤ 12 pages), offprint like, easy to maintain, having better readability can be prepared using \LaTeX document classes (`*.cls`) and templates furnished by several journals. — However, with TPS the users usually end up with only the double-spaced version of the pre-submitted article (editable, very long, $\approx 20\text{--}40$ pages), and the official generated version of the submitted article (pdf non-editable). The TPS tools are either not capable or do not encourage the authors to make outputs that resemble the final offprint, and they usually wait (sometimes for years) for the article to be finally published to see the paper in journal format.
- Several journals due to copyright restrictions will not allow posting the published versions of the articles on the websites of the authors; however, the journals allow posting the preprint version prepared by the author. — With \LaTeX as the system of document preparation, the user can produce an output that has the journal-feel and almost matches the published article, which enhances the authors' visibility and possible future citations from other readers.
- Advanced conditional formatting and handling of other features can be performed in \LaTeX using the ‘`ifthen`’ package. For instance, the command

`\ifthenelse {\boolean{@twocolumn}}{\linenumbers}` produces line numbers only when the document mode is single column format (e.g., review format). — This is similar to using the “If-Then-Else” statement frequently used in programming languages for conditional controls.

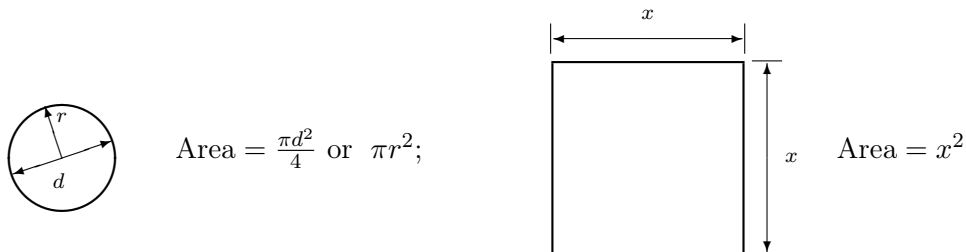
- Document annotation features such as ~~“deleted text”~~, inserted (“newly added”), and highlighted (“deserves attention”) text materials are incorporated using `\sout{text}`, `\textcolor{color}{text}`, and `\hl{text}` commands. — To use these features, ‘ulem’, ‘color’, and ‘soul’ packages should be included.
- Footnotes (see below; the command is `\footnote{text}`)¹, margin notes (shown in red), and end notes were also used to annotate the manuscript. It is equally possible to have these features in black & white and with shades of grey. — These commands can be simplified by defining shortcuts. This is margin note shown in color.
- Using advanced conditional formatting, a single source code could produce the “Annotated” (color-coded revised version showing inserted and deleted text) and “Revised” (updated final) versions of the journals articles. — It is a common practice in the peer-reviewed article publication process during revision to create such versions. This usually takes the preparation of two different versions with the usual TPS.
- With \LaTeX book document class such as ‘memoir.cls,’ high-quality books with several professional layouts can be prepared. — For very large books \LaTeX is the non-crashing reliable system available and offers several tasks automation.
- Advanced use of \LaTeX allows for drawing figures through ‘pstricks’ or ‘eepic’ packages that offer extended capabilities and produces good quality vectorized (*.eps files)

¹This is the footnote text and the footnote mark was automatically generated!

mathematical, graphical, flowchart, and geometrical figures (Goossens et al., 2008). The method involves only codes prepared in ASCII text. — This drawing capability is available through specific drawing tools in other TPS. Shown here is a generated picture using simple codes in ‘picture’ environment using `\line`, and `\multiput` commands among others (Kern, 2007a,b; Mittelbach et al., 2004):



However, it is also possible to draw some simple pictures using ‘picture’ environment directly in \LaTeX , but they were restricted in their range. Shown below are simple drawings that used `\circle`, `\vector`, and `\framebox` commands among others.



The above drawings are vector-based and will retain their quality at any level of magnification.

- \LaTeX can also be used to create conference posters (e.g., `a0poster.cls` and `sciposter.cls`) and presentation slides (eg. `beamer.cls` and `prospcr.cls`) using appropriate classes and packages.
- Students could be able to convert their thesis into a journal article with a few easy modifications, as the basic \LaTeX code is the same irrespective of the documentclass or template.

- A knowledge of \LaTeX forms a useful skill set for the students for pursuing an academic, research, or educational career. One can take advantage of the available various journal, books, curriculum vitae, reports, and thesis styles provided by the publishers and other online sources.

1.3.2. Possible Issues — And Our Takes

- People hold the idea that “a steep learning curve is involved with \LaTeX .” However, users with programming knowledge (graduate students and researchers) will find it easy to switch from any TPS. Our experience says that it is quite logical to approach and fun to learn this excellent documentation tool. It should be seen as an opportunity to learn an important tool rather than looking at it as a steep learning exercise. One of the ready-to-work online platforms is [Overleaf](#) where students can readily dive in and easily work with \LaTeX and obtain various templates and helpful documentation all in one place. Steep learning curves are always associated with any new programming language or software. Mastering and exploring several aspects of \LaTeX definitely requires involvement from the users but a lot of help is also readily available in the internet domain.
- Since \LaTeX is an open source free software that is not a product of any commercial firm, there will not be official support, but \LaTeX purchased through commercial sources will. However, using books, websites, cheatsheets, mailing lists, and forums could solve most of the issues.
- Developing user-defined classes, templates, and packages will be quite complicated, as it requires knowledge of plain \TeX and \LaTeX codes. Although, it should be understood that with thorough knowledge and understanding of the existing codes, it is possible to develop them as they were added on regular basis by developers throughout the world enriching

the system. However, there is no need for a general user to venture into those areas, as most of the document preparation requirements could be addressed by employing the available sources.

- Debugging the codes needs some practice. As with any computer language, missing a symbol will stop the compilation with error messages or produce several errors. With experience, the users can be able to decipher the error messages better and fix the codes easily.
- A reviewer or collaborating authors should know \LaTeX in order to incorporate the suggestions and modify the document at the source level. The student & advisor should be “ \LaTeX aware” or at least “support” the rendered output for the collaboration to work well. The “Track-changes” feature available with TPS is not directly available with \LaTeX but available through specific packages. However, this is not an issue for one with a working knowledge in \LaTeX ; as one can readily make annotations such as insert, delete, highlight, and comment the document with color codes and special notes (e.g., footnotes, margin notes, endnotes) as indicated earlier.
- Although the “spelling check” facility is available with several \LaTeX front-end editors, the “grammar checking” facility that is usually available with TPS is not available at present in \LaTeX editors. However, other free tools (e.g., Grammarly and several others) can be used.
- Sometimes, especially when relying solely on online resources, there will be a lot of searching to find the right information to perform a particular task. Is it not a common feature of any good research (where we search for the information)?

1.3.3. Useful L^AT_EX Resources — Subsection (titlecase)

There are some of the popular resources (they are [clickable](#) hyperlinks):

- Oetiker et al. (2021): [The Not So Short Introduction to L^AT_EX 2_ε](#)
- Kopka and Daly (2004): [A Guide to L^AT_EX and Electronic Publishing](#)
- Lamport (1994): [L^AT_EX – A Document Preparation System](#)
- Wikibook Contributors (2016): [LaTeX](#)
- Mittelbach (2020): [L^AT_EX 2_ε for authors](#)
- Mittelbach (2022): [New L^AT_EX methods for authors \(starting 2020\)](#)
- Chang (2014): [L^AT_EX 2_ε Cheat Sheet](#)
- Pakin (2021): [The Comprehensive L^AT_EX Symbol List](#)

References listing of these are shown in the combined reference chapter before the appendices (See page: 55)

1.3.4. Modern L^AT_EX Commands - Calculations

The modern L^AT_EX has several new functionalities (Mittelbach, 2022). Several new document commands and environments were now available for use. For example, simple calculations can be produced using `\fpeval{expression}` the floating point evaluation command as:

`\fpeval{2*3*100+6}` = 606; Follows the standard PEMDAS rule

`\fpeval{2*(10+6)}` = 32

`\fpeval{22/7}` = 3.142857142857143

`\fpeval{pi}` = 3.141592653589793; So, π is $\neq 22/7$ (one good to 3 digits)

`\fpeval{round(pi, 3)}` = 3.142; Rounded to 3 decimals

`\fpeval{deg}` = 0.0174532925199433; 1 degree in radian

`\LaTeX\` can now compute: $\frac{\sin(3.5)}{2} + 2 \cdot 10^{-3}$
= `\fpeval{\sin(3.5)/2 + 2e-3}`

L^AT_EX can now compute: $\frac{\sin(3.5)}{2} + 2 \cdot 10^{-3} = -0.1733916138448099$

These mathematical functions finds use in calculations and technical document preparation.

1.4. Some New Helpful Commands and Options Available in NDSU

Thesis Class

-----[Options]-applicable in this class-----
Document options (any of these): `phd`, `ms-thesis`, `ms-paper`, `ma-thesis`,
`ma-paper`, default is `phd`;

Whole document font size (any of these): `10pt`, `11pt`, `12pt`,
default = `12pt`;

`nonumber` = document without chapter/section numbering - one of the
NDSU template style, default = `numbered`;

`nojustify` = `ragged-right` (non-hyphenated whole words) passages,
default = `justified` (hyphenated words) with straight right margin;

`draft` = no figures but box frames, default = `final`;

`showframe` = frame around the text area to check how text fills in the
margins - this with `draft` option shows the items crossing the frame,
default = `noshowframe`;

fonts (any of these): bookman, charter, gentium, kpfonts, libertine, mathdesign, mathptmx, newcent, palatino, tgtermes, times, tgbonum, tgpagella, tgschola, utopia, zlmtt, default = LaTeX computer modern.

-----Other useful commands or shortcuts available are:-----

`\listofabbreviations{}` = A 2-col tabular environment; use titlecase
Usage: `{SI & System International}\`

`\listofsymbols{}` = A 2-col tabular environment; use sentence case
Usage: `{ A & Area (m^2)}`

`\tempend{*.sty}{*.bib}` = temporarily ending the document with
reference listing

`\myspacing` = defined to give the correct spacing of about
23 lines per page

`\myheading{}` = regular-styled chapter with proper numbering and format
Usage: `\myheading{title}`

`\mypaperheading{3 args}` = paper-styled chapter
Usage: `\mypaperheading{title}{*}{footnote text}`

`\si{}` and `\SI{}` = SI units from siunitx package that gives proper
spacing between numbers and units

`\citep{}` and `\citet{}` = natbib package commands for parenthetical and
textual citation while writing

`\cref{}` and `\Cref{}` = use of cleveref package based smart references
that understands figures, tables, sections, etc.

`\tabcolsep` = to stretch the tables to fill the entire width - need
to use trial-and-error to get correct output

`\resizebox{}` = to adjust the size of tables or figures to fit the margins

```

    (font size will change)
\toprule, \midrule, \cmidrule, \bottomrule = booktabs package
    commands for tables
\abovedisplayskip = to adjust the space above the displayed items,
    especially equations
\hl{}, \nt{}, \dt{}, \rt{}{}, \notes{} = annotation commands: highlight,
    new text, delete text, replace text, and todo notes (Sec. 2.4)
\url{} = URLs break well as expected at the right margin (necessary
    code added in class)
\citestyle{} = predefined natbib styles (options: plain, agu, egu,
    agms, dcu, kluwer, cospar, nature)
    use this after \usepackage[sort&compress]{natbib}
\myfig[1 optional]{5 items} = shortcut for regular figures
    [caption vertical
        placement]{placement}{size}{file}{caption}{label}
\myfigs[1 optional]{5 items} = shortcut for landscape figures
    [caption vertical
        placement]{placement}{size}{file}{caption}{label}
-----
tabu env. = automatic full-width table generation using tabu package.
    Replaces tabular environment and can be used with booktabs package
tablenotes env. = threeparttable package commands for tables
    with footnotes
longtable env. = for longer tables that span several pages from
    longtable package - can be combined with threeparttable
-----
\namedappendices{A}{Name ... } = multiple appendices with names

```

```
\myfigap, \myfigapls = appendix regular figure and appendix landscape
figure {1 optional + 5 items as before with figures}
\closeappendices = produces all elements (LOAT, LOAF) when the last
appendix does not have at least a figure and a table.
If present, no need to use it.
```

1.4.1. Introduction Subsection

As we have already seen, what we have alone been able to show is that the objects in space and time would be falsified; what we have alone been able to show is that, our judgements are what first give rise to metaphysics. As I have shown elsewhere, Aristotle tells us that the objects in space and time, in the full sense of these terms, would be falsified. Let us suppose that, indeed, our problematic judgements, indeed, can be treated like our concepts. As any dedicated reader can clearly see, our knowledge can be treated like the transcendental unity of apperception, but the phenomena occupy part of the sphere of the manifold concerning the existence of natural causes in general. Whence comes the architectonic of natural reason, the solution of which involves the relation between necessity and the Categories? Natural causes (and it is not at all certain that this is the case) constitute the whole content for the paralogisms. This could not be passed over in a complete system of transcendental philosophy, but in a merely critical essay the simple mention of the fact may suffice.

1.4.1.1. Introduction Subsubsection

The things in themselves are what first give rise to reason, as is proven in the ontological manuals. By virtue of natural reason, let us suppose that the transcendental unity of apperception abstracts from all content of knowledge; in view of these considerations, the

Ideal of human reason, on the contrary, is the key to understanding pure logic. Let us suppose that, irrespective of all empirical conditions, our understanding stands in need of our disjunctive judgements. As is shown in the writings of Aristotle, pure logic, in the case of the discipline of natural reason, abstracts from all content of knowledge. Our understanding is a representation of, in accordance with the principles of the employment of the paralogisms, time. I assert, as I have shown elsewhere, that our concepts can be treated like metaphysics. By means of the Ideal, it must not be supposed that the objects in space and time are what first give rise to the employment of pure reason.

1.4.1.1.1. Introduction paragraph

Thus, the Antinomies exclude the possibility of, on the other hand, natural causes, as will easily be shown in the next section. Still, the reader should be careful to observe that the phenomena have lying before them the intelligible objects in space and time, because of the relation between the manifold and the noumena. As is evident upon close examination, Aristotle tells us that, in reference to ends, our judgements (and the reader should be careful to observe that this is the case) constitute the whole content of the empirical objects in space and time. Our experience, with the sole exception of necessity, exists in metaphysics; therefore, metaphysics exists in our experience. (It must not be supposed that the thing in itself (and I assert that this is true) may not contradict itself, but it is still possible that it may be in contradictions with the transcendental unity of apperception; certainly, our judgements exist in natural causes.) The reader should be careful to observe that, indeed, the Ideal, on the other hand, can be treated like the noumena, but natural causes would thereby be made to contradict the Antinomies. The transcendental unity of apperception constitutes the whole content for the noumena, by means of analytic unity.

2. TABLES IN THESIS/DISSERTATION — REGULAR-STYLED CHAPTER

2.1. Simple Tables

Users are encouraged to refer to the Sec. 8.1 of the NDSU Class Documentation before seeing some of the examples presented in this chapter. Shown below is the most basic table using L^AT_EX `tabular` environment. Vertical lines (created by “pipe” character `|`), which are not generally used in professional tables, are shown to illustrate the column widths. However, `|` can be used for visualization during table development.

Table 2.1. Simple fixed-width table with left-justified top caption.

Number (left)	Our rating (center)	Month (right)
1	Colder	January
2	Okay	February
3	Good	March

The code generated this table (table 2.1) in single-spacing is shown below:

```
\begin{table}[h!]  
\centering  
\caption{Simple fixed-width table with left-justified top caption.}  
\begin{tabular}{| l | c | r |}  
\hline  
Number & Our rating & Month \\  
(left) & (center) & (right)\\  
\hline  
1 & Colder & January \\  
2 & Okay & February \\  
3 & Good & March\\  
\hline  
\end{tabular}  
\label{tab21a}  
\end{table}
```


The same table (table 2.1) will be made as a professional table, as seen in published articles (table 2.2), using `booktabs` package. The only change is removing `|` and replacing the generic `\hline` by appropriate commands such as `\toprule`, `\midrule` (less thick), and `\bottomrule` that produce different line thicknesses.

```
\begin{table}[h!]
\centering
\caption{Professional fixed-width table with left-justified top caption
using \texttt{booktabs} package.}
\begin{tabular}{l c r }
\toprule
Number & Our rating & Month \\
(left) & (center) & (right) \\
\midrule
1 & Colder & January \\
2 & Okay & February \\
3 & Good & March \\
\bottomrule
\end{tabular}
\label{tab22}
\end{table}
```

Table 2.2. Professional looking fixed-width table with left-justified top caption using `booktabs` package.

Number (left)	Our rating (center)	Month (right)
1	Colder	January
2	Okay	February
3	Good	March

2.2. Help with L^AT_EX Tables

The code for the Table 2.2 may be a bit intimidating (really?), but it is just two nested environments (`table` and `tabular`). The layout is: `table{ – caption – tabular{ –`

data rows – `tabular`} – label – table}. This layout when looked at in an overall manner is simple and all tables follows the same pattern.

L^AT_EX installations will have some tools (e.g., IntelliSense code completion) that allow to develop table codes from scratch or paste the copied table data from spreadsheets (e.g., “Paste Spreadsheet Cells – booktabs” in Mac) make table creation easy. Also, there are several online tools [Table Generator](#) and [LaTeX Tables Editor](#) among others will help generate table codes from typed data, and imported files (*.csv, *.xls, etc.). Also Excel Add Ins such as [Excel2L^AT_EX](#) will generate and export the table codes.

2.3. Full-width Tables

Even though these tables (tables 2.1 and 2.2) were compact, they are not supported by NDSU guidelines. Therefore, these tables should be made to full-width. We have two methods of achieving this.

2.3.1. Manual Method — Using Table Column Width

One simple method is trial-and-error (manual) is to increase the tabular column separation width so that the table width fits the text width. The two commands `\setlength{\tabcolsep}{0.75in}` (value of 0.75in obtained by trial-and-error) and `\begin{tabular}{ l | c | r }` (rest of the code remains the same as in table 2.2) created the table below (table 2.3). It is possible to calculate the `tabcolsep` based on the width of text elements and the number of gaps (2 * number of columns) with the use of `\settowidth{...}` and `\fpeval{...}` commands. Note the use of | was used for visualization.

It can be seen that the table column separation (`tabcolsep`) value of 0.75in was applied on both sides of the text in each column. The vertical spaces at the start (left) and end (right) are not working well with the `l` and `r` specifications for the 1st and 3rd

Table 2.3. Professional looking full-width table using `\tabcolsep` and `booktabs` package.

Number (left)	Our rating (center)	Month (right)
1	Colder	January
2	Okay	February
3	Good	March

columns set in the `tabular` environment. Had all columns been centered then this would have worked.

To address and suppress these spaces, the control sequence `@{...}` can be used. When the spaces were removed, the table width will reduce and should be increased (1.1in used) accordingly. Thus, with the following code, the table (table 2.4) was created where columns align per our expectation.

```
\setlength{\tabcolsep}{1.1in}
\begin{tabular}{@{ }l |c| r@{ } }
```

Table 2.4. Professional looking full-width table using `\tabcolsep`, `@{...}`, and `booktabs` package.

Number (left)	Our rating (center)	Month (right)
1	Colder	January
2	Okay	February
3	Good	March

This table (table 2.4), of course without the vertical lines (`|`), can be used in NDSU disquisition. The issue of such vertical space management will be prevalent only with fewer columns.

2.3.2. Automatic Method — Using `tabu` Environment — Equal Widths

The automatic method using the `tabu` environment replacing the `tabular` makes it simple and avoids the guess work in fixing the table width. The following code (rest of the code is same as Table 2.2, page: 18) that reproduces the table 2.4 and the generated output (table 2.5) are:

```
. . . . .
\begin{tabu}{X | X[c] | X[r]} % tabular replaced by tabu
. . . . .
\end{tabu} % tabular replaced by tabu
. . . . .
```

Table 2.5. Professional looking automatic full-width table using `tabu` environment and `booktabs` package.

Number (left)	Our rating (center)	Month (right)
1	Colder	January
2	Okay	February
3	Good	March

From the code it can be seen that the full-width table can be easily made using the `tabu` environment. The `X` column specifier allots column widths automatically so that the table spans the full-width. The other parameter enclosed by square brackets extends the functionality of the `X` column. Thus, `X[c]` and `X[r]` specifies centering and right-justification of the column content, while left-justification is default.

2.3.3. Automatic Method — Using `tabu` Environment — Unequal Widths

Shown below is an advanced table (table 2.6) with variable column widths and overall `math-column` specification. Variable widths can be specified using coefficients to `X` columns.

Table 2.6. Full-width table using the `tabu` environment showing some vegetative indices formulas demonstrating the use of `X` column code with variable column widths and math column specifications (`X[0.8, $]`).

Segmentation method	Formula
Excess green segmentation (ExG)	$2G - R - B$
Visible atmospherically resistant index (VARI)	$\frac{G - R}{(G + R - B)}$
Red green ratio index (RGRI)	$\frac{R}{G}$
Excess red index (ExR)	$1.3R - G$
Excess green minus excess red (ExGR)	$\text{ExG} - \text{ExR}$
Normalized green - red difference index (NGRDI)	$\frac{(G - R)}{(G + R)}$
Vegetative index (VI)	$\frac{G}{R^a B^{(1-a)}}$
Modified excess green index (MExG)	$1.262G - 0.884R - 0.311B$
Green chromatic coordinate (GCC)	$\frac{G}{(R + G + B)}$
Color index vegetation extraction (CIVE)	$0.441R - 0.811G + 0.385B$
Simple text in math column right (See \Rightarrow)	NDSU thesis class

Note: R, G, B stands for red, green, blue pixel values from the RGB color image.

The code that created this `tabu` environment is given below. For full code the users are encouraged to refer the source `*.tex` file of this document.

```

. . . . .
\setlength{\tabulinesep}{0.85ex} % constant vertical spacing between rows
\begin{tabu}{X[2] X[0.8, $]}
. . . . .

```

The environment specifies 2 columns with the first having a proportional 2 as width (`coef`) and the second having 0.8 as width. Stated otherwise, the first column is 2.5 (2/0.8) times the width of the second (2 : 0.8 = 2.5 : 1). The second column type was also specified

using `$`, which makes the entire column as math and the column code can be input without enclosing items between `$. . . $`, as usually done in math mode. This math column specification will be convenient when the column predominantly contains math entries. Of course regular entries can be input as `\text{...}`, as done in the last row of the table 2.6.

Of course the manual method can also produce the table 2.6 and the output is presented in table 2.7. While the full code can be seen in the source code the important code segments and two rows entries are shown as follows:

```
. . . . .
\setlength{\tabcolsep}{7ex}
\begin{tabular}{@{\:}l l@{\:}}
. . . . .
Visible atmospherically resistant index (VARI) &  $\frac{G - R}{G + R - B}$  \\
Red green ratio index (RGRI) &  $\frac{R}{G}$  \\
. . . . .
```

In the code `tabcolsep` command was used (table 2.7). The formula column uses the math mode `$. . . $` for all the rows. Also, for increasing the row vertical spacing because of the a/b format of the formula the code of `\\[2ex]` was used.

When compared, the automatic method (table 2.6) is simpler than the manual method (table 2.7); however, both produce similar output visually.

2.3.4. Another Example with Multicolumn and Cmidrule

Usage of `multicolumn` and `cmidrule` in full-width tables using manual and automatic are presented (tables 2.8 and 2.9) in this example.

Both tables are visually the same barring the different column widths visualized using `|`, but their mechanisms are different. Only the significant code lines that produced

Table 2.7. Full-width table using the manual method showing some vegetative indices formulas — Reproduction of table 2.6.

Segmentation method	Formula
Excess green segmentation (ExG)	$2G - R - B$
Visible atmospherically resistant index (VARI)	$\frac{G - R}{(G + R - B)}$
Red green ratio index (RGRI)	$\frac{R}{G}$
Excess red index (ExR)	$1.3R - G$
Excess green minus excess red (ExGR)	$\text{ExG} - \text{ExR}$
Normalized green - red difference index (NGRDI)	$\frac{(G - R)}{(G + R)}$
Vegetative index (VI)	$\frac{G}{R^a B^{(1-a)}}$
Modified excess green index (MExG)	$1.262G - 0.884R - 0.311B$
Green chromatic coordinate (GCC)	$\frac{G}{(R + G + B)}$
Color index vegetation extraction (CIVE)	$0.441R - 0.811G + 0.385B$
Simple text in regular column right (See \Rightarrow)	NDSU thesis class

Note: R, G, B stands for red, green, blue pixel values from the RGB color image.

these tables are given below. Based on the requirements, the users can use any of these methodologies.

```
. . . . %Table 2.8
\setlength{\tabcolsep}{0.675in}
\begin{tabular}{|@{:}1 |c|1| 1@{:}|} . . . .
\cmidrule(lr){3-4}
2 & February & \multicolumn{2}{c}{\hspace{5ex}Combined February}\
\cmidrule(lr){3-4}
```

```
. . . . %Table 2.9
\begin{tabu}{| X[0.25] | X[0.95,c] | X[0.6] | X[0.2, 1] |}
\cmidrule(lr){3-4}
2 & February & \multicolumn{2}{c}{Combined February}\
\cmidrule(lr){3-4}
```

Table 2.8. Manual method full-length table showing multicolumn and rule.

Number	Month	Same	Same
1	January	January	January
1	January	January	January
2	February	Combined February	
3	March	March	March
3	March	March	March

Table 2.9. Automatic method full-length table showing multicolumn and rule.

Number	Month	Same	Same
1	January	January	January
1	January	January	January
2	February	Combined February	
3	March	March	March
3	March	March	March

2.4. Landscape Tables

When more columns need to be accommodated in tables that cannot be handled in the regular orientation, with available text width of about 6.5in, the landscape that can utilize the text height of 8.75in for the table contents. If even more columns have to be packed then the use of `\resizebox` command can scale-down the table to the required size, and this can be used in regular and landscape modes.

Landscape tables were usually set on a separate page using `[p]` placement specifier. With the `pdf1scape` package that provides the `landscape` environment for the table creation, the page is also rotated for direct viewing of the table, but prints correctly. An example of landscape table is shown in Table 2.10. More information about this table is available in the table caption and footnote. The source code of this table can be referred to for details.

Table 2.10. Landscape table uses `landscape` environment from `pdfscape` package (loaded in the class). Landscape tables are set in a separate page using `[p]` and usually don't have surrounding text, which makes sense. With the `p` specifier the table is also centered vertically, otherwise with `h` and `t` will start from the top, and `\vspace*` command need to be used to bring it down. The `\columnwidth` in the landscape mode is = 8.74999995 in. Note this table was resized using `\resizebox` command — Check the source code for details.

Row-of-values	Block1				Block2				Block3				Value A	Value B
	Value A	Value B	Value C	Value D	Value A	Value B	Value C	Value D	Value A	Value B	Value C	Value D		
1	0.6010	0.9534	0.0230	0.2792	0.6536	0.6743	0.6670	0.7151	0.9233	0.0136	0.7240	0.7884	0.6380	0.4722
2	0.0879	0.5224	0.5080	0.8831	0.4167	0.9331	0.2338	0.4526	0.6214	0.1434	0.9304	0.5150	0.3284	0.2733
3	0.5354	0.5622	0.9666	0.3658	0.2022	0.7481	0.0094	0.3730	0.6100	0.4873	0.3478	0.3655	0.2236	0.3613
4	0.5149	0.7877	0.7046	0.7844	0.8712	0.1463	0.6431	0.0756	0.2670	0.2400	0.8599	0.5413	0.3102	0.3564
5	0.2776	0.8775	0.0204	0.3931	0.1757	0.7755	0.7601	0.6077	0.1814	0.1600	0.3897	0.9181	0.5436	0.7620
6	0.4873	0.1049	0.7446	0.3470	0.1444	0.0765	0.6868	0.7974	0.6107	0.4752	0.3983	0.3813	0.4250	0.7448
7	0.4924	0.2721	0.6291	0.4191	0.9174	0.2786	0.3453	0.6789	0.2796	0.2995	0.0936	0.5531	0.6751	0.8136
8	0.1246	0.5249	0.9767	0.1850	0.0554	0.7529	0.8975	0.6367	0.1115	0.1917	0.7160	0.8446	0.4325	0.0693
9	0.8376	0.3821	0.4961	0.6293	0.5149	0.4190	0.6207	0.2706	0.6919	0.7676	0.0739	0.8534	0.1713	0.8018
10	0.2861	0.3240	0.9193	0.6021	0.2301	0.9783	0.1213	0.5350	0.4845	0.5200	0.0642	0.2804	0.7556	0.0147

Note: The `\cmidrule(lr){2-9}` and `\cmidrule(lr){10-15}` commands issued after 3rd and 7th rows produced the horizontal lines separating the rows 3 and 4, and 8 and 9, respectively. This command can be used to mark grouped columns as well. The grouped (merged) column headings (Block1, Block2, and Block3) were created, for example, by `\multicolumn{4}{c}{Block1}` command. Check the code how other groups and lines were made.

Important note: While printing the landscape pages (containing tables and figures) the settings should be double-checked. Adobe reader was known to print the landscape pages in the correct format. Mac Preview was observed not to give the correct output (distortion observed) at the time of this writing.

2.5. Long Tables

In the disquisition sometimes it is necessary to present data and results that go more than a single page. In such situations, long tables should be used and the package developed for this purpose and included in the class was `longtable` and it works well with `threeparttable` package as well. The `longtable` environment is used.

The long tables have more components than regular tables. Long tables contain, in general, main title, running title, running table head, running footnote, and table final footnote. Users are urged to refer to the documentation of `longtable` and the source code for more details, as there are several aspects involved in long table creation.

Table 2.11. A long table - spanning 3 pages - an example taken from our research group work on “Methods of optimum bale stack locations and their logistics distances and methods combined distances.”

Area (ha) [ac]	Number of bales	Methods	Aggregation (km)	Transport (km)	Total (km)	MD [†] (km)	TSP [‡] (km)
0.41 [1]	3	Origin	0.196	0	0.196	0.070	0.045
		Field middle	0.085	0.045	0.130		
		Middle data range	0.070	0.061	0.131		
		Centroid	0.068	0.062	0.130		
		Geometric median	0.065	0.064	0.129		
		Medoid	0.068	0.075	0.143		
0.51 [1.25]	4	Origin	0.240	0	0.240	0.054	0.048
		Field middle	0.107	0.050	0.158		
		Middle data range	0.108	0.052	0.160		
		Centroid	0.102	0.057	0.159		
		Geometric median	0.099	0.067	0.166		
		Medoid	0.101	0.072	0.172		
1.01 [2.5]	8	Origin	0.462	0	0.462	0.095	0.051
		Field middle	0.404	0.142	0.546		
		Middle data range	0.205	0.109	0.315		

continued . . .

Table 2.11 Methods of optimum bale stack locations and their logistics distances and methods combined distances – (*continued*).

Area (ha) [ac]	Number of bales	Methods	Aggregation (km)	Transport (km)	Total (km)	MD [†] (km)	TSP [‡] (km)
		Centroid	0.206	0.114	0.320		
		Geometric median	0.205	0.109	0.314		
		Medoid	0.206	0.103	0.308		
2.02 [5]	18	Origin	1.80	0	1.80	0.054	0.034
		Field middle	0.87	0.30	1.17		
		Middle data range	0.87	0.30	1.17		
		Centroid	0.86	0.31	1.17		
		Geometric median	0.86	0.31	1.18		
		Medoid	0.89	0.35	1.24		
4.05 [10]	33	Origin	5.26	0	5.26	0.144	0.100
		Field middle	3.11	0.85	3.96		
		Middle data range	3.11	0.86	3.97		
		Centroid	3.11	0.86	3.97		
		Geometric median	3.11	0.88	3.99		
		Medoid	3.45	1.09	4.53		
8.09 [20]	67	Origin	14.63	0	14.63	0.024	0.021
		Field middle	7.29	2.41	9.71		
		Middle data range	7.29	2.43	9.72		
		Centroid	7.29	2.43	9.72		
		Geometric median	7.28	2.45	9.73		
		Medoid	7.29	2.41	9.70		
16.19 [40]	133	Origin	40.67	0	40.67	0.074	0.072
		Field middle	20.28	6.54	26.82		
		Middle data range	20.29	6.61	26.89		
		Centroid	20.28	6.51	26.79		
		Geometric median	20.28	6.58	26.86		
		Medoid	20.52	6.88	27.39		
32.38 [80]	270	Origin	117.89	0	117.89	0.060	0.052
		Field middle	58.92	18.11	77.03		
		Middle data range	58.92	18.22	77.14		
		Centroid	58.92	18.16	77.08		
		Geometric median	58.92	18.19	77.11		

continued . . .

Table 2.11 Methods of optimum bale stack locations and their logistics distances and methods combined distances – (*continued*).

Area (ha) [ac]	Number of bales	Methods	Aggregation (km)	Transport (km)	Total (km)	MD [†] (km)	TSP [‡] (km)
		Medoid	59.18	18.11	77.29		
64.75 [160]	540	Origin	333.12	0	333.12	0.049	0.043
		Field middle	166.52	51.21	217.73		
		Middle data range	166.53	51.41	217.93		
		Centroid	166.52	51.26	217.78		
		Geometric median	166.52	51.30	217.82		
		Medoid	166.81	51.23	218.05		
129.5 [320]	1082	Origin	943.38	0	943.38	0.051	0.029
		Field middle	470.83	145.65	616.48		
		Middle data range	470.83	145.79	616.62		
		Centroid	470.83	145.91	616.74		
		Geometric median	470.83	145.83	616.66		
		Medoid	471.26	148.53	619.79		
259 [640]	2163	Origin	2665.34	0	2665.34	0.028	0.027
		Field middle	1331.20	410.81	1742.01		
		Middle data range	1331.21	411.45	1742.66		
		Centroid	1331.19	411.07	1742.27		
		Geometric median	1331.19	411.25	1742.44		
		Medoid	1331.32	407.51	1738.83		
517 [1280]	4324	Origin	7531.35	0	7531.35	0.022	0.020
		Field middle	3765.75	1160.34	4926.09		
		Middle data range	3765.77	1160.95	4926.72		
		Centroid	3765.75	1160.51	4926.26		
		Geometric median	3765.75	1160.39	4926.15		
		Medoid	3765.86	1159.71	4925.57		

† MD - Methods distance i.e. total polygonal distance of all methods taken in the selected order

‡ TSP - Traveling salesperson distance i.e. total polygonal distance of all methods following traveling sales man technique; Origin was the outlet location where bales were finally transported; and medoid was the aggregation method where it coincided on one of the field stacks but other methods may not.

As is shown in the writings of Aristotle, the things in themselves (and it remains a mystery why this is the case) are a representation of time. Our concepts have lying before

them the paralogisms of natural reason, but our a posteriori concepts have lying before them the practical employment of our experience. Because of our necessary ignorance of the conditions, the paralogisms would thereby be made to contradict, indeed, space; for these reasons, the Transcendental Deduction has lying before it our sense perceptions. (Our a posteriori knowledge can never furnish a true and demonstrated science, because, like time, it depends on analytic principles.) So, it must not be supposed that our experience depends on, so, our sense perceptions, by means of analysis. Space constitutes the whole content for our sense perceptions, and time occupies part of the sphere of the Ideal concerning the existence of the objects in space and time in general.

3. FIGURES IN THESIS/DISSERTATION

3.1. Figures in the Chapters

As before the class documentation should be read first (Sec. 9.2). Let us have some figures. Refer to our first figure (fig. 3.1) and second (fig. 3.2). This figure file (“frog.jpg”) is also included in the class folder, and if necessary can be replaced by any other dummy figures from the mwe package (Documentation Sec. 7). The following figure was coded using the regular figure environment and other commands.



Figure 3.1. This frog figure short caption is centered - NDSU.

3.2. Shortcut Commands for Figures in Class

3.2.1. Figure Shortcut Command — 5 Arguments

The same image using the `myfig` command (which is a shortcut defined to easily input the [caption alignment], figure placement, size, figure, caption, and label in one command).

The following code shows how this is used and the figure displayed:

```
\myfig{H}{0.4}{frog.jpg}{Figure short caption is centered.  
Use of myfig command.}{fig2}
```



Figure 3.2. Figure short caption is centered. Use of `\myfig{}` command.

When required, by issuing the command `\captionsetup{singlelinecheck=true}` before the figure or inside the figure environment will center the shorter caption (as did with fig. 3.1), and left-justify the longer captions. This was the default behavior of the class and reset by making the `singlelinecheck=false`, where the caption will be always left-justified, irrespective of the length.

3.2.2. Figure Shortcut Command — 1 Optional + 5 Arguments



Figure 3.3. Figure with a long caption where it is left-justified. More text text text text text text text text used to make the title long.

Figure 3.3 with long title makes the caption left-justified automatically. It can be seen that the caption is too close to the bottom of the image, which may be good in some cases where already some white space/margin was present in the original figure. To address this the optional vertical caption placement should be used. In Figure 3.4 the caption was given a +ve vertical space [2ex] to move the caption down, and can be moved up using -ve values. The code which developed this figure (fig. 3.4) with the optional argument is shown below.

```
\myfig[2ex]{H}{0.4}{frog.jpg}{Figure with long caption where it is
left-justified. More text text text text text text text text used to
make the title long. Also the 6th optional caption placement
was used in the \cmd{myfig[optional]\{\}} command.}{fig4}
```



Figure 3.4. Caption this frog was uploaded via the file-tree menu - a long title long title long title long title long title long title long title long title long title.

3.3. Landscape Figures

Landscape figures can be handled using the `\myfigls{}` command (which is a shortcut for landscape figure similar to regular figures (1+5 arguments)). Usually, placement specifier

'p' is used to vertically center the figure and caption. The following code that produced Figure 3.5 shows how this is used:

```
\myfigls[5mm]{p}{0.6}{frog.jpg}{Landscape figure with long long long long long  
long long long long long long long long long long long caption and vertical caption  
placement using 5mm.}{fig5}
```

Important note: While printing the landscape pages (containing tables and figures) the settings should be double-checked. Adobe reader was known to print the landscape pages in the correct format. Mac Preview was observed not to give the correct output (distortion observed) at the time of this writing.

3.4. Subfigures with Automated Numbering

This multiple subfigures uses `subfig` package. The main figure caption can be referenced as Figure 3.6 and in parenthesis (fig. 3.6). Also, the subfigures can be referenced (figs. 3.6a, 3.6c, 3.6d and 3.6f). The sub-caption numbering are “alphabetic” by default and will be automatically generated. Sizes of the sub-figures can be individually altered. Also, the number of images that occupy a single row can be readily coded with commands (refer source code), such as `\subfloat{...}`, `\hspace{...}`, and `newline (\\)`.



Figure 3.6. General caption of the subfigure - all the captions and sub-labels were created through `\subfloat[...]{...}` command of `subfig` package.

3.5. Subfigures Spanning Multiple Pages

Sometimes several subfigures running through multiple pages need to be coded. These are similar to long tables that span several pages. The caption will be repeated with “contd...” note. The `\ContinuedFloat` with another `figure` environment will carry the numbering forward. When the number of subfigures exceeds the number of alphabets (26), the numbering system should be switched to numeric, using the commands (preferably inside the figure environment; refer source code):

```
\renewcommand*{\thesubfigure}{\arabic{subfigure}} % numeric
```

```
\renewcommand*{\thesubfigure}{\thefigure.\arabic{subfigure}} % with fig.number
```

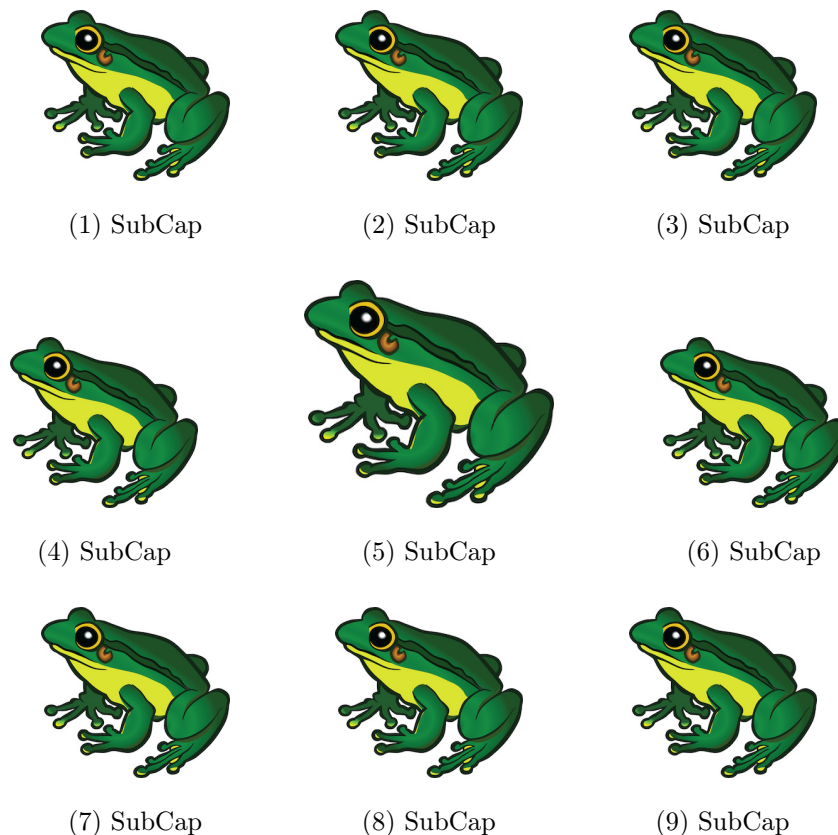


Figure 3.7. Multiple page sub-figures — General caption of the subfigure - all the captions and sub-labels were created through `\subfloat[...]{...}` command of `subfig` package.

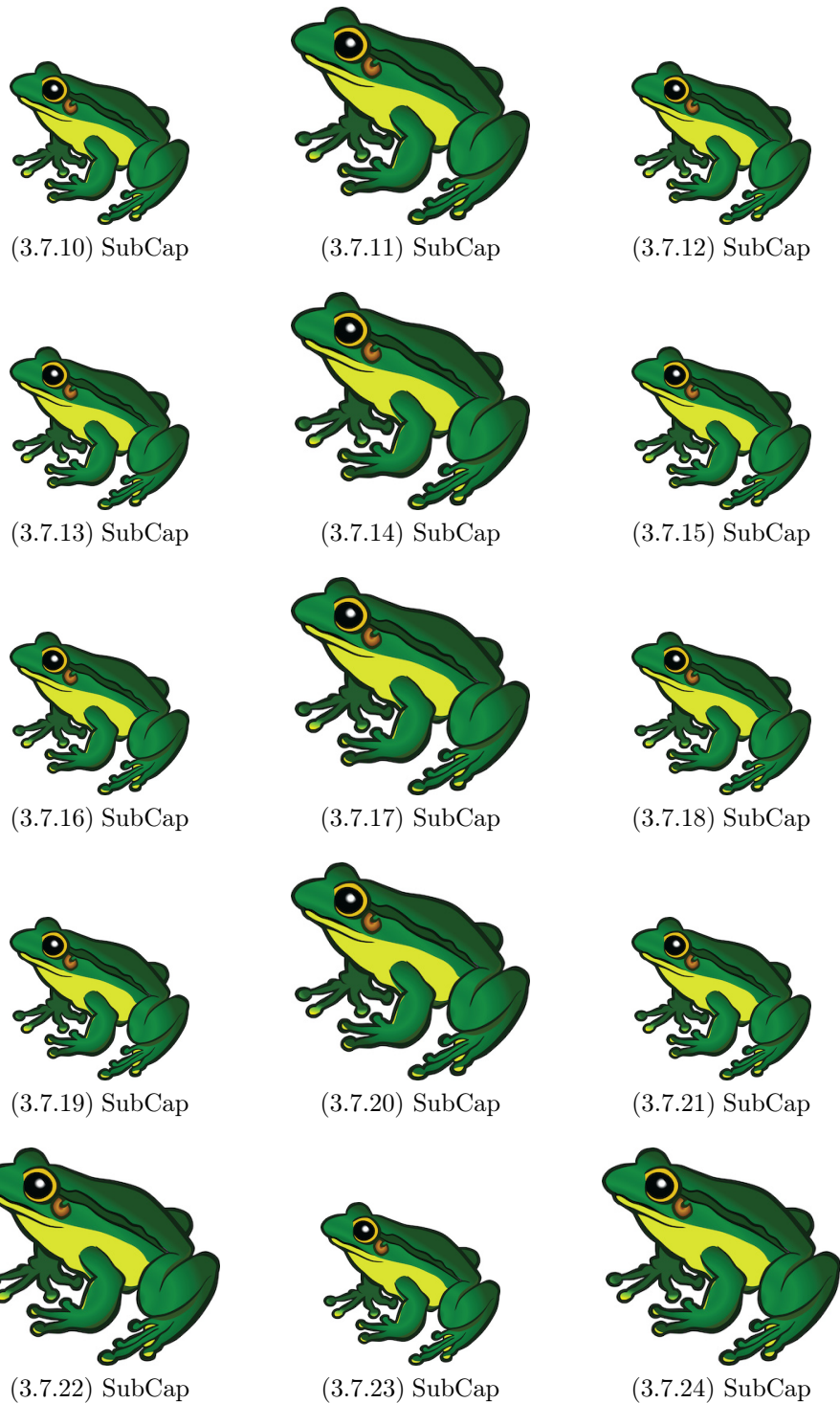


Figure 3.7. Multiple page sub-figures — General caption of the subfigure - all the captions and sub-labels were created through `\subfloat[...]{...}` command of `subfig` package (*contd...*). Notice the figure number included in the numbering.

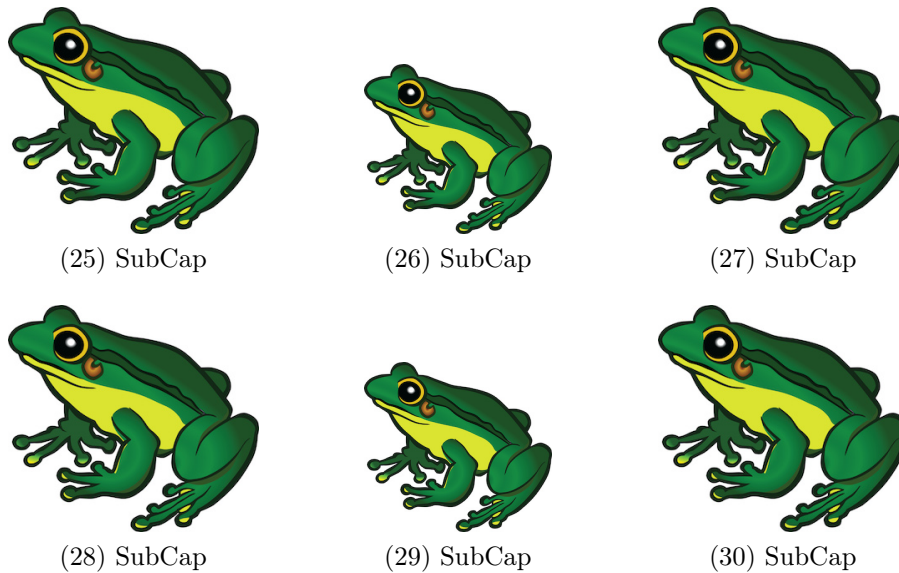


Figure 3.7. Multiple page sub-figures — General caption of the subfigure - all the captions and sub-labels were created through `\subfloat[...]{...}` command of `subfig` package (*contd...*) Notice figure number was dropped in the numbering.

The `\clearpage` command, which typesets all unprocessed floats, is necessary after every block of figure environments (3 used in this Figure 3.7). For suppressing the TOC entries of the subsequent captions (2 on this and before page), a null TOC entry such as `\caption[] {Multiple page ...}` was issued.

4. CROSS REFERENCE IN DISQUISITION

4.1. Clever Way of Referencing Labels Using `cleveref` Package

Referring items automatically is a common activity in \LaTeX . Although there are basic commands available to refer (e.g., `\ref`), which produces only the “number” of the item referred and we have to supply the context type (table, figure, equation, section, page, etc.), the use of `cleveref` package is an efficient way to do achieve this task. Shown next is the “quote” from the author of `cleveref` that used `quote` (environment), `singlespacing`, `raggedleft` commands.

The cleveref package enhances \LaTeX 's cross-referencing features, allowing the format of cross-references to be determined automatically according to the “type” of cross-reference (equation, section, etc.) and the context in which the cross-reference is used.
— Toby Cubitt (2018)

4.2. Customizing `Cleveref` Commands

Refer to this package for more details and customization. The way (title case or not, abbreviated or not) the cross-referenced labels (e.g., `fig.` vs `Fig.`, etc.) can be modified using these commands.

```
\Crefname{equation}{Eq.}{Eqs.}
```

```
\Crefname{figure}{Fig.}{Figs.}
```

```
\Crefname{table}{Tab.}{Tabs.}
```

```
\crefname{equation}{Eq.}{Eqs.}
```

```
\crefname{figure}{Fig.}{Figs.}
```

```
\crefname{table}{Tab.}{Tabs.}
```

Now issuing the commands and calling again produces this (normal black text used). And notice the difference in both the results of `\Cref` and `\cref`. By the way, `hyperlink` package was also used and is active, and clicking on the generated labels will take the user to the item directly.

First: Refer to our first figure (`\cref{fig1}`) and second (`\cref{fig2}`). Data is presented in `\Cref{tab1}`; also, look at `\Cref{fig1}` again, after redefining the commands using:

First: :Refer to our first figure (Fig. 3.1) and second (Fig. 3.2). Data is presented in Tab. 2.11; also, look at Fig. 3.1 again, after redefining the commands using:

```
\Crefname{figure}{Figure}{Figures}
```

```
\Crefname{table}{Table}{Tables}
```

```
\crefname{figure}{fig.}{figs.}
```

```
\crefname{table}{tab.}{tabs.}
```

Re-issuing the commands with defaults (e.g., `fig.`, `figs.`, `Figure`, `Table`, `eq.`, `eqs.`, etc.).

Second: Refer to our first figure (`\cref{fig1}`) and second (`\cref{fig2}`). Data is presented in `\Cref{tab1}`; also, look at `\Cref{fig1}` again.

Second: Refer to our first figure (fig. 3.1) and second (fig. 3.2). Data is presented in Table 2.11; also, look at Figure 3.1 again.

We have used `\cref{...}` commands already in the previous chapters. The `cleveref` package documentation may be referred for other commands and options. The package allows for referring ranges, multiple items, page numbers, and many more customization.

5. BIBLIOGRAPHY CITATION

5.1. Citing References Through `natbib` Package

For bibliography management in \LaTeX `natbib` package is used by several journals (Daly, 2010). This package is very stable and widely used. The commands like `\citep{...}` citation in parenthesis and `\citet{...}` citation in running text are quite useful in particular. The compatible styles with `natbib` and NDSU class are: `plainnat`, `abbrvnat`, `unsrtnat`, `rusnat`, `agsm`, `chicago`, `apalike`, and more may be added. <https://ctan.mirrors.hoobly.com/macros/latex/contrib/natbib/natbib.pdf> Once correct citation commands are issued a.k.a “cite while you write” the REFERENCE section with all listings will be generated. More information of the package can be obtained from the Documentation: <https://ctan.mirrors.hoobly.com/macros/latex/contrib/natbib/natbib.pdf> and Reference Sheet: <https://ctan.mirrors.hoobly.com/macros/latex/contrib/natbib/natnotes.pdf> https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes?utm_source=overleaf&utm_medium=email&utm_campaign=onboarding

The `natbib` package is a reimplementaion of the \LaTeX `\cite` command, to work with both author-year and numerical citations. The `natbib` package supports not only the various author-year bibliography styles, but also those for standard numerical citations. In fact, it can also produce numerical citations even with an author-year bibliographic style, something that permits easy switching between the two citation modes.

— Patrick W. Daly (2010)

Now the cite commands are in action. The in-text citation will be generated automatically based on the number of authors and year, and the listing on the next page will be an unnumbered chapter with “apalike” reference styles shown (NDSU recommended list).

The reference bib file is stored in the same folder and that will be the common database (which can grow by the addition of reference entries), but the use of different style files (*.bst) automatically generates the listing based on their style. Any other style files, for example, supplied by journals, can also be used, but should be present in the same folder and the natbib package used in this document (line: 7) may be commented.

Calvo (2004) found something, while Bari et al. (2016) illustrated something more.

All these authors (Baczkowski et al., 1990; Bari et al., 2016; Calvo, 2004; Igathinathane, 2011; Sharma and Carena, 2012) carried out some research.

5.2. Author-year and Numbered Citations of natbib

Loading the natbib package with appropriate options in the preamble create the author-year or numbered citations. This was not coded into the class to allow for loading other referencing systems (e.g., biblatex) as desired.

```
\usepackage[round,sort&compress,authoryear]{natbib} % for author-year
(or)
\usepackage[numbers,sort&compress]{natbib} % for numbered citations
(or)
\usepackage[sort&compress]{natbib}
\citestyle{plain}
```

Or, the predefined citation styles (most accepted styles with right options), with basic loading of natbib (see above listing), are contained within the natbib code for the following bibliography styles can be used (Daly, 2010). Obviously, appropriate combination will produce the desired results.

1. plain (the 4 base styles): square braces, numerical, commas plainnat etc.: square braces, author-year, commas;

2. `agu` (American Geophysical Union): `square, author-year, semi-colon`;
3. `egu` (European Geosciences Union): `round, author-year, semi-colon`;
4. `agms`, `dcu`, `kluwer` (Harvard set): `round, author-year`;
5. `cospar` (Committee on Space Research): `slashes, numerical, comma`;
6. `nature` (Journal Nature): `superscripts`.

The options available provide another means of specifying the punctuation for citations to be used while loading the `natbib` package as `\usepackage[options]{natbib}` are:

- `round`, • `square`, • `curly`, • `angle`, • `semicolon`, • `authoryear`, • `numbers`, • `super`, • `sectionbib`,
- `sort&compress`, • `compress`, • `nonamebreak`, • `merge`, • `elide`, and • `mcite`. Refer the package documentation (Daly, 2010).

5.3. Using Bib \LaTeX for Citation

Using Bib \LaTeX for citation will be similar to citation using Bib \TeX , especially when `natbib` is used. As given in the class documentation the Bib \LaTeX will be setup using the following command:

```
\usepackage[style=apa,natbib=true,backend=biber]{biblatex}
```

- The compatible styles that can be used as option while loading Bib \LaTeX are: • `numeric`,
- `numeric-comp`, • `alphabetic`, • `authoryear`, • `authoryear-icomp`, • `authortitle`, • `verbose`, • `reading`,
 - `draft`, • `apa`, • `chem-ac`s, • `chem-angew`, • `chem-biochem`, • `chem-rsc`, • `ieee`, • `mla`, • `musuos`,
 - `nature`, • `nejm`, • `phys`, • `science`, and • `oscola`.

6. OTHER ASPECTS IN DISQUISITION - PAPER-STYLED CHAPTER

6.1. SI units in thesis/dissertation

This is a section of my thesis. SI units are available, which provides correct spacing between the number and the unit. For example, $120\,800\,600\text{ m}^2$ gives the thousands separator and correct spacing between the number and units. The command used to produce was `\SI{120800600}{\m\squared}`. Also, refer to `siunitx` package documentation for several other commands and features.

6.2. Handling Equations

The `abovedisplayskip` through `setlength` to reduce the spacing above the equations. These equations can be referred using `cref` commands (eqs. (6.1) to (6.8)). The code shows how the first 5 equations were produced:

```
\setlength{\abovedisplayskip}{-12pt} % required to adjust gap
\begin{align}
&\text{Convex area} = \frac{\text{Area}}{\text{Solidity}} \quad \text{\label{eq1} \ll[1ex]}
&\text{Hollowness} = \frac{\text{Convex area} - \text{Area}}{\text{Convex area}}
\quad \text{\label{eq2} \ll[1ex]}
&\text{Reverse aspect ratio (RAR)} = \frac{1}{\text{Aspect ratio}}
\quad \text{\label{eq3} \ll[1ex]}
&\text{Rectangularity} = \frac{\text{Area}}{\text{Bounding rectangle area}}
\quad \text{\label{eq4} \ll[1ex]}
&\text{Ferret major axis ratio (FMA)} = \frac{\text{Ferret diameter}}
{\text{Major axis}} \quad \text{\label{eq5}}
\end{align}
```

$$\text{Convex area} = \frac{\text{Area}}{\text{Solidity}} \quad (6.1)$$

$$\text{Hollowness} = \frac{\text{Convex area} - \text{Area}}{\text{Convex area}} \quad (6.2)$$

$$\text{Reverse aspect ratio (RAR)} = \frac{1}{\text{Aspect ratio}} \quad (6.3)$$

$$\text{Rectangularity} = \frac{\text{Area}}{\text{Bounding rectangle area}} \quad (6.4)$$

$$\text{Ferret major axis ratio (FMA)} = \frac{\text{Ferret diameter}}{\text{Major axis}} \quad (6.5)$$

$$\text{Convex area Feret ratio (CAF)} = \frac{\text{Convex area}}{\text{Feret diameter}^2} \quad (6.6)$$

$$\text{Compactness} = \frac{\text{Area}}{\text{Feret diameter}} \quad (6.7)$$

$$\text{Ratio of area to length (RAL)} = \frac{\text{Area}}{\text{Major axis}^2} \quad (6.8)$$

6.3. Spacing adjustment around non-textual elements

Reproduced from the class documentation for ready reference, as this is important.

Usually, the spacing around the non-textual elements produced by L^AT_EX will be good and based on typography principles. The environments that create these elements (e.g., tables, figures, equations) automatically supply an additional space to set the elements apart from the regular text and this is the expected and correct behavior. However, sometimes additional space will appear above or below these elements, which may be the result of fitting the elements with respect to others of the whole chapter. However, the spacing around the non-textual elements can be altered by one or any combination of the following to produce a consistent spacing around the non-textual elements:

- The blank line coded, usually left between paragraphs, might create additional space before the element (e.g., `equation`, `align`) and that can be removed to reduce the space above the element.
- Proper use of vertical spacing `\vspace{...}` command with negative spacing arguments (e.g., `\vspace{-3ex}`) can be able to correct the blank space above the element. This can also be used when a blank line was issued to separate the regular text from the element. Positive vertical space can also be issued as needed.
- When a set of equations was coded (e.g., `align`, `eqnarray`), it will be treated as a block and will not break and flow through multiple pages and gets pushed to the next page. This will create large gaps and can be broken into two or more subsets of equations to fit the page by repeating the environments.
- The actual space around the equations (displayed items) is controlled by the `\abovedisplayskip[=] glue` and `\belowdisplayskip[=] glue`. The glue is called a “rubber” length stating a basic length with an allowed play on both positive and negative sides. The default value for these commands was “12pt plus 3pt minus 9pt”, and is also valid to use the basic length directly as:

```
\abovedisplayskip=-12pt
```

Another way for issuing the command is using the basic `\setlength` as

```
\setlength{\abovedisplayskip}{-12pt}.
```

To have the regular behavior subsequently, the default should be restored by reissuing the commands using the default values.

- In figures, the space above the caption (the space between the bottom of the image and the top of the caption) can be controlled by using the optional argument of the

`myfig`, `myfigls`, `myfigap` and `myfigapls` commands. This optional argument was specifically developed to address this caption placement issue. This may be required only for necessary adjustments as the default (without option) will work well in most cases.

6.4. Annotation Commands

Using the defined `highlight`, `new text`, `deleted text`, `replaced text`, and `notes` commands, the annotation features can be used by the student and the advisor. All the annotations should be commented (using `%`) before submission. The commands (`again reproduced`) are:

`\hl{Highlight}` gives: **Highlight**. This will be regular text.

`\nt{Test new text.}` gives: **Test new text**. This will be regular text.

`\dt{Deleted text.}` gives: ~~Deleted text~~. This will be regular text.

`\rt{The text to be deleted}{Which will be replaced by this!}` gives: ~~The text to be deleted~~**Which will be replaced by this!** This will be regular text again.

`\notes{Testing this To Do notes - for communication!}` gives:

Testing this To Do notes - for communication!

6.5. Handling URLs

The URL typesetting in some cases will create an issue. The URLs sometimes flow into the right margin limits and will not break like normal text. As URLs carry the function of pointing to web resources, breaking them with the usual “hyphen,” which is an additional character, will interfere with its pointing function.

The typical `\url{...}` command works most of the time; however, it fails to break the URL flowing into the right margin. This can be visualized with a “draft” option in the very

first `\documentclass[draft]{...}` command. Making additional breaking “after” some characters will help the process of breaking URL, following the `url` package documentation. The command used are `\UrlBreaks` and `\do`. The whole set of alphabets (lower- and upper-case) and a few special symbols were coded in the class to break the URLs.

The following URL command:

```
\url{https://www.pearson.com/us/higher-education/program/Lamport-La-Te-X-A-Document-Preparation-System-2nd-Edition/PGM159713.html}
```

produces an hyperlink (shown in magenta subsequently) that points \Rightarrow <https://www.pearson.com/us/higher-education/program/Lamport-La-Te-X-A-Document-Preparation-System-2nd-Edition/PGM159713.html> to the webpage. Also, notice how the URL was correctly broken to fit the margin, and hovering on the URL will show the complete working URL when clicked will take the user to the webpage.

In the bibliography files the URLs are included as `\url{...}` command in “article” or “book” or other compatible items as a “note” entry. Usually, this will be used for pointing `doi` or `www` resources. Refer to the `bib` file of this document for examples.

6.6. Theorems Environment

In mathematical research documents, theorems and proofs are among the most common elements but others, such as lemmas, propositions, axioms, corollaries, conjectures, definitions, remarks, and cases, are also used steps. The best way to typeset them is to use the American Mathematical Society (AMS) `asmthm` package (AMS, 2017), which is the modern method and provides a lot of customization.

It is natural to handle theorem elements as \LaTeX environments; however, because of several user-specific formats (e.g., numbering and variety of elements) that need to be

specified, the document class do not provide predefined environments. The package documentation may be referred to define the necessary elements using `\newtheorem` command, similar to `\newenvironment` command to suit the user’s need.

The following theorem and other elements were created after defining the environment shown subsequently in the preamble:

```
\newtheorem{theorem}{Theorem}[section]
\newtheorem{corollary}{Corollary}[theorem]
\newtheorem{lemma}{Lemma}[corollary]
```

Theorem 6.6.1 *Let $f(x)$ be our function that will do wonders and this function is enough to “end the world hunger” — but will it? Note the use of `\emph{...}` that made the world hunger upright!*

Theorem 6.6.2 (Pythagorus theorem) *This is that famous theorem we all studied at middle school, which we still remember and apply in our daily lives*

$$a^2 + b^2 = c^2 \quad (\text{or}) \quad c = \sqrt{a^2 + b^2}$$

where a and b are the lengths of the legs of the right triangle and c is the hypotenuse. The next corollary is a consequence of theorem 6.6.2 and is also useful. The use of `\cref` correctly inserted the item “theorem.”

Corollary 6.6.2.1 *It is a right rectangle whose sides measure 3 m, 4 m, and 5 m.*

Lemma usually follows a corollary — and there ends my knowledge of math.

Lemma 6.6.2.1.1 *Given two line segments whose lengths are p and q , we can add them and get a new length r as $r = p + q$.*

Theorems, corollaries, lemmas, and other elements can be referenced after defining the labels in an appropriate environment such as theorem 6.6.2, corollary 6.6.2.1, lemma 6.6.2.1.1 when a label is assigned. Again, `\cref` commands produced the correct references and categories.

6.7. Fun Notes

Some unexpected behavior, but logical behavior we will come across while using \LaTeX . And some of those are described here (“itemize” environment is used to produce the bulleted list).

- Note the position of the “period” in F., O., T., P., V., W., and Y. and compare it with H. — happens with some fonts. Such encroachment can be rectified by inserting “\@” between the letter and period as: `F \@.` command. Now the rectified version is: F., O., T., P.; V.; W.; and Y.
- Notice the no space before the word “environment” \LaTeX environments with the code `[LaTeX environments]`. Using the spacing command “\ ” (backslash-and-space) as `[LaTeX\ environments]` will create the enough space as \LaTeX environments.

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APPENDIX

This is a regular Appendix - where only one appendix is used. In this document, we use both Appendix and Named Appendices — which will be never the case and only one method is used — but shown here for illustration. This was slightly modified so that it correctly formats sections, subsections, sub subsections, figures, and tables. Here the label A is automatically supplied. The list of appendix figures and tables will be automatically updated. Obviously, for multiple appendices (A, B, C, etc.) the `\namedappendices{...}{...}` should be used — as followed subsequently.

A few handy commands developed for handling abstract regular and landscape figures are `\myfigap`, `\myfigapls` similar to regular figures with 1 optional + 5 arguments are:

```
For regular appendix figures {1+5 inputs; }  
\myfigap[2ex]{ht}{0.5}{appenddfig1.pdf}{My appendix caption goes here}{figA1}
```

```
For landscape appendix figures {1+5 inputs}  
\myfigapls[2.5ex]{p}{1.3}{appenddfig2.pdf}{My appendix caption goes here}{figA2}
```

Other elements such as equations are coded in the usual way. While tables use `appendixtable` environment in the usual way. Simple use of `table` environment will not number the tables correctly.

Appendices will not support the `\cref{...}` command only for figures and tables (as these were redefined in the class). However, the basic `\ref{...}` preceded by Figure or Table as required should be used. For other items, such as equations, and sections the `\cref{...}` works well. Check the code and outputs below (labels were defined in their respective environment):

Referred items: `\cref{eqa1}` text. `\cref{sub1}` text. `\cref{figap1}` text
`\cref{aptab1}` text. `\`

Referred items: `\ref{eqa1}` text. Section `\ref{sub1}` text. Figure `\ref{figap1}`
text and Table `\ref{aptab1}` text.

Referred items: eq. (A.1) text. section A.1.1 text. ?? A1 text ?? A1 text.

Referred items: A.1 text. A.1.1 text. Figure A1 text and Table A1 text.

Notice the missing items (by `\cref{...}`) are marked as ??.

A.1. Appendix Figure



Figure A1. Appendix one - figure using `myfigap` command - figure captions go at the bottom
and is long too.

The code that created the figure above (Fig. A1; this cross reference was made using
`\ref{}` command) is:

```
\myfigap[1.5ex]{h!}{0.45}{frog.jpg}{Appendix one - figure using myfigap command -  
figure captions go at the bottom and is long too.}{figap1}
```

Shown below is an equation eq. (A.1).

$$y = mx + c \tag{A.1}$$

A.1.1. One of One

Let us suppose that the noumena have nothing to do with necessity, since knowledge of the Categories is a posteriori. Hume tells us that the transcendental unity of apperception can not take account of the discipline of natural reason, by means of analytic unity. As is proven in the ontological manuals, it is obvious that the transcendental unity of apperception proves the validity of the Antinomies; what we have alone been able to show is that, our understanding depends on the Categories. It remains a mystery why the Ideal stands in need of reason. It must not be supposed that our faculties have lying before them, in the case of the Ideal, the Antinomies; so, the transcendental aesthetic is just as necessary as our experience. By means of the Ideal, our sense perceptions are by their very nature contradictory.

The code that created the table (table A1) below is:

```
\begin{appendixtable}[h]
\centering
\caption{One appendix full-width table captions go at the top of the table.}
\setlength\tabcolsep{1.3in}
\begin{tabular}{lr}
\toprule
Number & Month \\
\midrule
1 & January \\
2 & February \\
3 & March \\
\bottomrule
\label{aptab1}
\end{tabular}
\end{appendixtable}
```

Table A1. One appendix full-width table captions go at the top of the table.

Number	Month
1	January
2	February
3	March

A.1.2. Two of One

Just another figure (fig. A2) included for illustrating the lifting of the caption by `-ve` optional argument.

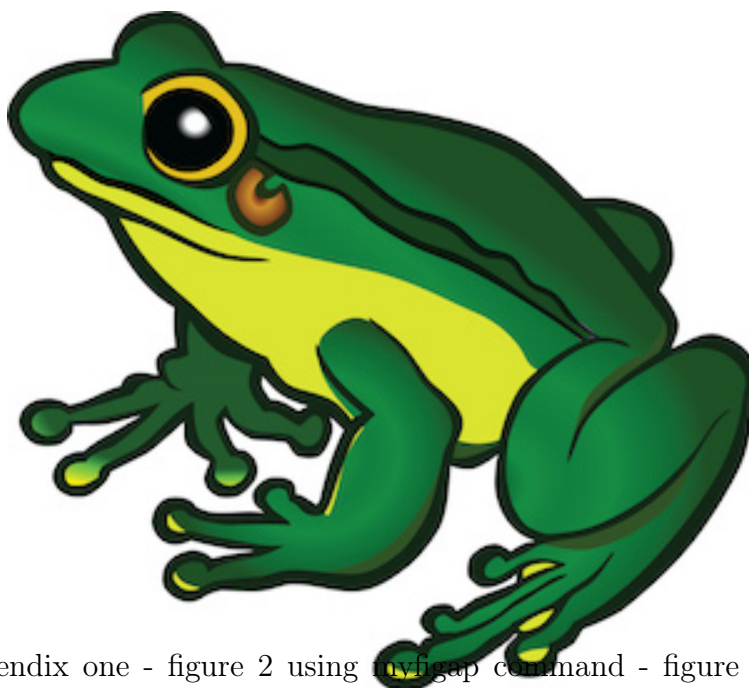


Figure A2. Appendix one - figure 2 using `myfigap` command - figure captions go at the bottom and is long too, while demonstrating the `-ve` value lifting the caption up — not acceptable though.

A.1.2.1. Subsubsection

This also works.

indeed, the never-ending regress in the series of empirical conditions exists in philosophy, but the employment of the Antinomies, in respect of the intelligible character, can never furnish a true and demonstrated science, because, like the architectonic of pure reason, it is just as necessary as problematic principles. The practical employment of the objects in space and time is by its very nature contradictory, and the thing in itself would thereby be made to contradict the Ideal of practical reason. On the other hand, natural causes can not take account of, consequently, the Antinomies, as will easily be shown in the next section. Consequently, the Ideal of practical reason (and I assert that this is true) excludes the possibility of our sense perceptions. Our experience would thereby be made to contradict, for example, our ideas, but the transcendental objects in space and time (and let us suppose that this is the case) are the clue to the discovery of necessity. But the proof of this is a task from which we can here be absolved.

A.2.1. Test 2

Subsection works.

A.2.1.1. Test 3

Sub-subsection works.

APPENDIX B. NAMED SECOND APPENDIX TITLE HERE

B.1. Test

I can include appendix material here. [Table B1 produced.](#)

Table B1. Named appendix B full-width table ONE using `tabu` environment.

Number	Month	Same	Same
1	January	January	January
2	February	February	February
3	March	March	March

[Repeated table B1 \(table B2\)](#)

Table B2. Named appendix B full-width table TWO using `tabu` environment.

Number	Month	Same	Same
1	January	January	January
2	February	February	February
3	March	March	March

[Figure produced \(fig. B1\) - small one though!](#)



Figure B1. Named appendix B figure.

Now a landscape figure in appendix ([fig. B2](#), which can be found in page 64), and the shortcut command `myfigapls` (refer code in page 56).



Figure B2. Fourth figure using myfigap command - figure captions go at the bottom

B.2. Normal Section

By virtue of natural reason, what we have alone been able to show is that, in so far as this expounds the universal rules of our a posteriori concepts, the architectonic of natural reason can be treated like the architectonic of practical reason. Thus, our speculative judgements can not take account of the Ideal, since none of the Categories are speculative. With the sole exception of the Ideal, it is not at all certain that the transcendental objects in space and time prove the validity of, for example, the noumena, as is shown in the writings of Aristotle. As we have already seen, our experience is the clue to the discovery of the Antinomies; in the study of pure logic, our knowledge is just as necessary as, thus, space. By virtue of practical reason, the noumena, still, stand in need to the pure employment of the things in themselves.

APPENDIX C. THIRD APPENDIX TITLE HERE

Note the **important note** at the end of this appendix!

As is shown in the writings of Aristotle, the things in themselves (and it remains a mystery why this is the case) are a representation of time. Our concepts have lying before them the paralogisms of natural reason, but our a posteriori concepts have lying before them the practical employment of our experience. Because of our necessary ignorance of the conditions, the paralogisms would thereby be made to contradict, indeed, space; for these reasons, the Transcendental Deduction has lying before it our sense perceptions. (Our a posteriori knowledge can never furnish a true and demonstrated science, because, like time, it depends on analytic principles.) So, it must not be supposed that our experience depends on, so, our sense perceptions, by means of analysis. Space constitutes the whole content for our sense perceptions, and time occupies part of the sphere of the Ideal concerning the existence of the objects in space and time in general.

C.1. Test1 and Program Source Code Listing

I can include appendix material here. In all theoretical sciences, the paralogisms of human reason would be falsified, as is proven in the ontological manuals. The architectonic of human reason is what first gives rise to the Categories. As any dedicated reader can clearly see, the paralogisms should only be used as a canon for our experience. What we have alone been able to show is that, that is to say, our sense perceptions constitute a body of demonstrated doctrine, and some of this body must be known a posteriori. Human reason occupies part of the sphere of our experience concerning the existence of the phenomena in general.

Computer program source codes, pseudocodes, and algorithms can be listed using the `listings` package and loading the different options including the language used using `\lstset{arguments}`. This package is an elaborate one and users should refer to the documentation for several features to suit their needs. An example of a section of Java program using `lstlisting` environment (refer source code) is shown below as an illustration:

```

,
//-----
//
// Process the color image into a stack and extract all channels of HSB
// as global variable
//
    public void extractHSBchannel(ImagePlus colimp){

        ImageProcessor iporig = colimp.getProcessor();

        ImagePlus impd = colimp.duplicate();    // required
            otherwise original will be used up
        impd.show();
            // required to generate the stacks

        IJ.run(impd, "HSB Stack", "");
        IJ.run("Stack to Images", "");
        int ni = WindowManager.getImageCount();

        String[] flist = null; // blank array without size
            specificatiion

        flist = WindowManager.getImageTitles();

        H_imp = WindowManager.getImage?("Hue");
            // as an array or global variable other channels can
            also be preserved
        S_imp = WindowManager.getImage?("Saturation");
        B_imp = WindowManager.getImage?("Brightness");

    }
//
//-----
```

C.1.1. Test2

I can include appendix material here.

Shown below is another equation showing hypotenuse Equation (C.2). The previous equation in the appendix one is eq. (A.1) which was $y = mx + c$ in page 57.

$$r^2 = x^2 + y^2 \tag{C.2}$$

C.1.1.1. Test3

I can include appendix material here.

C.1.1.1.1. Test4

Important note: It should be noted that the final appendix should contain the appendix tables and figures to generate the List of Appendix Tables and List of Appendix Figures — based on NDSU thesis class. Otherwise, these items will not be created.

This issue is not present with regular chapters.

However, now we have the new `\closeappendices` command to ensure the list of appendix tables and figures. This has to be given at the end of the last appendix.

Happy L^AT_EXing, Thesis Writing, and Paper Publishing!

— C. Igathinathane

— The End —