

THE TITLE OF YOUR THESIS OR DISSERTATION GOES IN THIS SPACE TO LET
US KNOW WHAT YOUR DOCUMENT IS ABOUT

A Thesis
by
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Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

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Committee Member 3
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ABSTRACT

This is the first numbered page, lower case Roman numeral (ii). Page numbers are outside the prescribed margins, at the bottom of the page and centered; everything else is inside the margins. No bold on this page (Exception: heading ABSTRACT is bold if major headings are bold. *This L^AT_EX template applies to this exception*).

Text begins two double spaces below the major heading. Recommended length of text is no more than 350 words. Vertical spacing is double spaced or space-and-a-half. (*This L^AT_EX template applies double space for this ABSTRACT.*) The same margin settings and text alignment are followed else where in this thesis. There should be no numbered references or formal citations in ABSTRACT.

The content of this ABSTRACT provides a complete, succinct snapshot of the research, addressing the purpose, methods, results, and conclusions of the research. As a result, it should stand alone without any formal citations or references to chapters/sections of the work. To accommodate with a variety of online database, images or complex equations should also be avoided.

The next pages are Dedication, Acknowledgments, Contributors and Funding Sources, and Nomenclature. Of these, Contributors and Funding Sources is required. The rest are optional.

DEDICATION

To my mother, my father, my grandfather, and my grandmother. To see what happens
with multiple lines, I extend this next part into a second line.

ACKNOWLEDGEMENTS

This section is also optional, limited to four pages. It must follow the Dedication Page (or Abstract, if no Dedication). If listing preliminary pages in Table of Contents, include Acknowledgments. Heading (ACKNOWLEDGMENTS) is bold if major headings are bold. It should be in same type size and style as text. So does vertical spacing, paragraph style, and margins. Also, ensure that the spelling of “acknowledgments” matches throughout the text and the table of contents.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

This work was supported by a thesis (or) dissertation committee consisting of Professor XXXX [advisor – also note if co-advisor] and XXX of the Department of [Home Department] and Professor(s) XXXX of the Department of [Outside Department].

The data analyzed for Chapter X was provided by Professor XXXX. The analyses depicted in Chapter X were conducted in part by Rebecca Jones of the Department of Biostatistics and were published in (year) in an article listed in the Biographical Sketch.

All other work conducted for the thesis (or) dissertation was completed by the student independently.

Funding Sources

Graduate study was supported by a fellowship from Texas A&M University and a dissertation research fellowship from XXX Foundation.

NOMENCLATURE

ARIMA	Autoregressive Integrated Moving Average
B/CS	Bryan and College Station
EPCC	Educator Preparation and Certification Center at Texas A&M University - San Antonio
EVIL	Every Villain is Lemons
FFT	Fast Fourier Transform
OGAPS	Office of Graduate and Professional Studies at Texas A&M University
SDCC	San Diego Comic-Con
TAMU	Texas A&M University

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1. INTRODUCTION

1.1 Author's Message to the Student Using This Template For Their Thesis or Dissertation

Howdy! This is the template for theses and dissertations written using \LaTeX for submission at Texas A&M University. Office of Graduate and Professional Studies at Texas A&M University (OGAPS) is here to guide you in submitting your thesis or dissertation. This template shows the many features of \LaTeX , with many more available to the user.

There are numerous guides, references, and tutorials available on the Internet to help you. If you are stuck, don't be afraid to conduct a Google search for your issue, or you can contact me at szroberson@exchange.tamu.edu or ogaps-latex@tamu.edu.

1.1.1 Brief Usage of the Template

This template is intended for use by STEM¹ students. If you are not a STEM student, this template is likely not for you.

The advantage of using this template over the Microsoft Word templates are numerous. First, there is a lot of control granted to the user in how the document looks. Of course, you are expected to still follow the guidelines set forth in the TAMU Thesis Manual. This template takes care of the margins, heading requirements, and front matter ordering for you.

Software to Install

MikTeX or **ProTeXt** is the free software recommended for Windows PC users to compile your \LaTeX document. To compile this document, the pdfLaTeX compiling engine is

¹Science, Technology, Engineering, and Mathematics. This is an example of a footnote. You can see that it is numbered and appended at the end of the page. Also, you can see the effect of having a multiline footnote.

used. Another software called **JabRef** is also recommended for bibliography/reference management; its usage is similar with EndNote.

Procedure to Compile L^AT_EX Document

This template (and consequently, your document) will be compiled using pdfLaTeX. To compile your document, do the following²:

- In TeXstudio, go to the Tools menu, then select Commands, and click pdfLaTeX.
- In Texmaker, go to the Tools menu and select pdfLaTeX.
- For other editors, consult the help files included with the editor.

To view the output after the program is done compiling, press F7 in TeXstudio and TeXmaker or the appropriate hotkey for other editors. Be sure that the document is not open in another PDF reader, for your editor will not display it.

1.1.2 How to Fill This Document

The document structure is organized in the main .tex file, TAMU_Thesis_Main.tex, which has the same name as the output PDF file. Content in each section is in the ‘Data’ folder. You can open the .tex files under the ‘Data’ folder to modify the content in each section. Four sections are added initially. To add in more sections into the L^AT_EX document, create a new .tex file in the ‘Data’ folder and add your new content to it. Then, open the TAMU_Thesis_Main.tex file and go to **line 71**. You can then add a

```
\include{./Data/MyNewSection}
```

command to include your new section. Note that the order in which the sections are included determines their order in your document.

²Notice here that I also show off the itemize environment for unordered lists. Ordered lists use the enumerate environment.

1.1.3 Reference Usage and Example

This subsection tests the usage of references. The book [2] is referred in this way. Actually, the option is available for you to change the default way references appear. The default and most commonly used option [3] is displayed here [4].

Unrelated citations are referred here for the test of reference section only [?]. If a reference is not defined in your bibliography file, question marks will show up in place of a the reference handle, like these [?]. Also note that only the material referenced appears in your bibliography regardless of how many entries are in your bibliography file.

For more information on using **JabRef**, citing sources, and changing the bibliography style, please see Appendix B.

1.1.4 Equations, Formulas, and Other Really Cool Math Things That \LaTeX Can Do

Equations can be written in \LaTeX in one of two ways. First, you can have material displayed inline by enclosing the desired statement in dollar signs. For example, $e^{i\pi} + 1 = 0$ is an inline math expression. Some longer expressions, especially those including sums, integrals, or large operators and objects can be displayed centered on their own line. In this **math mode**, you enclose the desired material in square brackets. For example,

$$\sum_{j=1}^n \int f_j \, dx = \int \sum_{j=1}^n f_j \, dx$$

is a math mode expression. We can also have a series of expressions aligned at a symbol. This is particularly useful when you are showing details in solving an equation or evaluating an integral. The next block shows off the *align** environment. We use it here to show a distributive property of set intersections over unions. Observe how each line is aligned to the biconditional symbol. This makes reading steps easier, since a reader can

go line by line and determine why each step is justified.

$$\begin{aligned}
 x \in A \cap \bigcup_j B_j &\iff x \in A \wedge x \in \bigcup_j B_j \\
 &\iff x \in A \wedge x \in B_k \text{ for some } k \\
 &\iff x \in \bigcup_j A \cap B_j
 \end{aligned}$$

There are many more commands and features available, but this document is too small to contain them.³ Many guides are available on the Internet for your use.

1.1.5 Using Acronyms

Provided in this template is a file named 'nomenclature.sty'. This file allows you to define acronyms and other nomenclature that will be used throughout your document. The advantage of using such a system is it remembers if you have defined/used an acronym before. For example, in the first section of this chapter OGAPS was defined. On every subsequent use only OGAPS will be printed.

If you open the 'nomenclature.sty' file, there will be a lot of formatting at the top of the document, but all you need to worry about is what happens starting after the 'Begin Acronym Definitions' comment. After this section there are many commands of the form:

```

\DeclareAcronym{EVIL}{
short = EVIL,
long  = Every Villain is Lemons
}

```

The *DeclareAcronym* command is used to set up an acronym, with the first input (EVIL) being the reference for the acronym. Within the actual definition there are two options: short and long. The short option sets the acronym to display, in this case EVIL,

³Yes, I pulled a Fermat. But really, a Google search will likely help you find what you need to do.

while the long options sets the definition of the acronym, in this case Every Villain is Lemons. To use the acronym, you would use the *ac* command and the acronym reference. In most cases the acronym reference can/will be the same as the short option. Some sample code is shown below for the EVIL acronym, with the typeset output following.

```
The first time that I use \ac{EVIL}, it will define the acronym.  
Every time I use \ac{EVIL} after that, it will show only the long form
```

The first time that I use Every Villain is Lemons (EVIL), it will define the acronym. Every time I use EVIL after that, it will show only the short form

There are many other *ac* commands and other options in the *DeclareAcronym* command that will help tailor acronyms to your specific needs. I refer you to the [Acro Package](#) documentation for that information if it is needed.

1.1.6 A Test Section

This is just a test.

1.2 Specifications in This TAMU L^AT_EX Template

All requirements for theses can be found in the most recent version of the Thesis Manual, available at the OGAPS website. The Thesis Office will be happy to assist you if you have questions about formatting. Questions specific to L^AT_EX should be directed to `ogaps-latex@tamu.edu`.

1.2.1 Another Test Section

Hello, is it me you're looking for?

1.2.2 Yet Another One

She called me late last night to say she loved me so.

1.2.3 No Surprises Here

Insert another song lyric here.

2. PAGES WITH A FIGURE, A TABLE, AND AN EQUATION

2.1 Figures: Placement, Size, and Captions

This is a figure template.

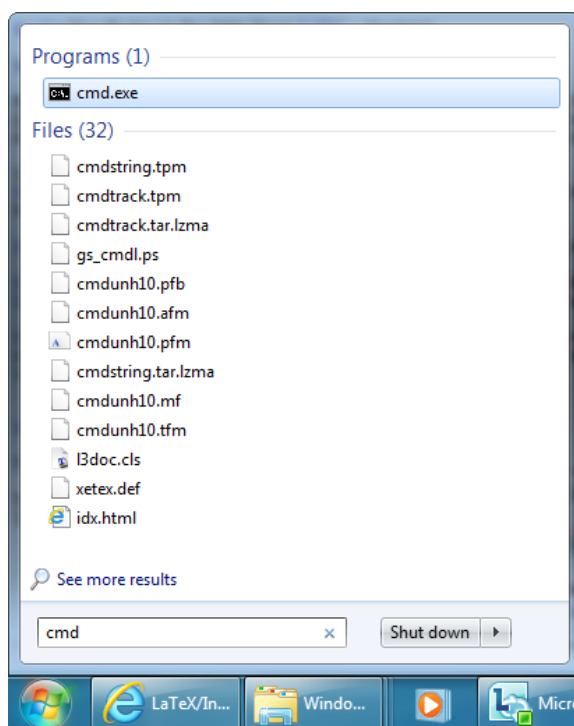


Figure 2.1: The command line compiler in Windows. It is not suggested that you compile using this method. See compilation instructions in the README.

Figure (and table) titles should be consistent through the document. All captions should be placed either above or below the object it describes. This is done by placing the *caption* in the correct place. While continued figures are allowed by the Thesis Manual, it is not suggested that any continued figures be included in a L^AT_EX document.

The figure below is taken from R. While there are packages available to import graphics from R, MATLAB, and similar software, it is probably best to export plots generated by these programs as a PDF or PNG file, and then import it via the *includegraphics* command.

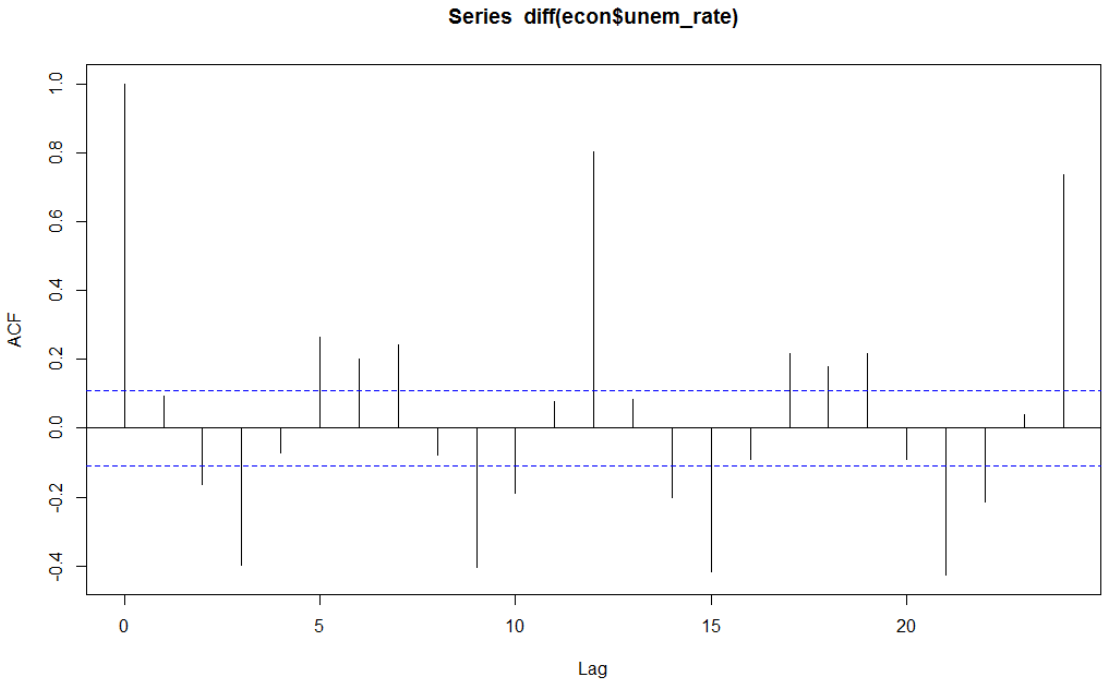


Figure 2.2: The autocorrelation function (ACF) of the differenced unemployment series. Seasonal adjustments may be needed.

2.2 Table Placement, Size and Table Title

Here is a table, displaying band and auxiliary scores from the 2011 Arcadia Festival of Bands held in Arcadia, CA [5].

The table is sorted by band score. There is more text here to demonstrate how the template handles spacing between tables and body text. Also note how the table caption is in a smaller font size than the body text.

School Name	Band Score	Auxiliary Score
Rancho Bernardo	96.15	89.15
Mt. Carmel	95.30	83.55
Riverside King	93.85	91.75
Diamond Bar	93.20	88.60
El Dorado	92.80	95.45
Chino	92.65	91.45
Henry J. Kaiser	92.60	87.55
Glendora	92.60	89.15
Montebello	90.50	82.70
Mira Mesa	89.65	91.50

Table 2.1: Scores from the 2011 Arcadia Festival of Bands.

2.3 Equations

The following format is recommended to be used to display equations.

$$y = c_1 \cos(t) + c_2 \sin(t) \tag{2.1}$$

$$e^{it} = \cos(t) + i \sin(t) \tag{2.2}$$

Equation 2.1 is the general solution to the differential equation $y'' + y = 0$. In the source code, the *ref* command allows you to refer to an equation by a label you created. References must be made after the equation has been created; attempting to refer to an equation before it is defined results in a question mark placeholder. Some more sample equations are below. Notice the first set below is not numbered.

$$\begin{aligned}
 \log(x^n) &= \log(x \cdot x \cdot \dots \cdot x) \\
 &= \log x + \log x + \dots + \log x \\
 &= n \log x
 \end{aligned}$$

$$X^T X \mathbf{u} = X^T \mathbf{y} \quad (2.3)$$

$$u(x, t) = \int_{-\infty}^{\infty} G(x, \tau) \exp \left(-\frac{(t - \tau)^2}{4kt} \right) d\tau \quad (2.4)$$

$$\mathcal{L}(f) = \int_0^{\infty} e^{-st} f(t) dt \quad (2.5)$$

$$\mathcal{F}(f) = \frac{1}{2\pi} \int_{-\infty}^{\infty} e^{i\omega x} f(x) dx \quad (2.6)$$

You can use labels to refer to equations you create. 2.6 is the **Laplace transform** used extensively in differential equations. 2.3 is the matrix representation of the **normal equations** used in least-squares regression.

To have equations without labels appearing the right margin, simply add an asterisk to the name of the environment (equation, align, etc.) when making the declaration.

2.4 Theorems and Proofs: Examples

This section will show an example usage of the theorem and proof environments, typically used for mathematics students. To use these environments, you must have the package **amsthm** declared in the preamble of your document. For this template, this is already declared in the main file. You may choose to remove this declaration if your document will not make use of theorems and proofs.

Theorems can be numbered, as the one below is, or you can force a different label to appear. For example, you can state the Bolzano-Weierstass theorem and have the names appear as the theorem label. See the examples below.

Sometimes you may have a theorem with multiple parts or multiple conditions. You can use other list environments, such as enumerate, inside the theorem environment declared to list these conditions. The final example at the end of this block shows this with the Invertible Matrix Theorem, which has several equivalent statements.

Theorem 1. Suppose f is of class C^1 and g is of class C^2 , and that the compact set D and its boundary satisfy the hypotheses of Green's Theorem. Then

$$\iint_D f \nabla^2 g \, dA = \oint_{\partial D} f(\nabla g) \cdot \mathbf{n} \, ds - \iint_D \nabla f \cdot \nabla g \, dA.$$

Proof. Begin with the integral of $f \nabla g \cdot \mathbf{n}$ taken over the boundary of D . By the second vector form of Green's Theorem,

$$\begin{aligned} \oint_{\partial D} f \nabla g \cdot \mathbf{n} \, ds &= \iint_D \nabla \cdot (f \nabla g) \, dA \\ &= \iint_D f \nabla^2 g + \nabla f \cdot \nabla g \, dA. \end{aligned}$$

Rearranging yields the desired. □

Theorem 2 (Bolzano-Weierstrass). *Every bounded real sequence has a convergent subsequence.*

Theorem 3 (Invertible Matrix Theorem¹). *For any square matrix A with n rows and columns, the following are equivalent.*

1. A is invertible.
2. The equation $A\mathbf{x} = \mathbf{0}$ has only the trivial solution $\mathbf{x} = \mathbf{0}$.
3. For any nonzero \mathbf{b} , $A\mathbf{x} = \mathbf{b}$ has exactly one solution.
4. The columns of A form a linearly independent set.
5. Zero is not an eigenvalue of A .
6. A has full rank.

¹This is an incomplete list.

7. *The determinant of A is not zero.*

There is currently no set format on how propositions and theorems should be laid out in the document. The idea is to remain consistent. It is best to not customize the appearance of theorems so that they can easily be distinguished from body text - just like figures, tables, and headings.

2.5 Another Table Example

For the sake of testing the appearance of the list of tables, a second table will be displayed here. This table displays a list of some major universities and their enrollments during fall 2015. This table is sorted in descending order of enrollment.

School	City and State	Fall 2015 Enrollment
Texas A&M University ²	College Station, TX	64,376
Ohio State University ³	Columbus, OH	58,322
Iowa State University	Ames, IA	36,001
University of California, San Diego	La Jolla, CA	33,735
University of West Florida	Pensacola, FL	12,798
Massachusetts Institute of Technology	Cambridge, MA	11,319

Table 2.2: Some major universities and their fall 2015 enrollments.

Naturally, tables and footnotes do not go together. If you attempted to write a footnote inside a table, there will be nothing at the bottom of the page, yet the footnote marker will still appear. To remedy this, the *footnote* package has been loaded from the *mdwtools* package. Check your TeX distribution to see if *mdwtools* is installed. See the source code for how this is implemented.

²Gig 'em!

³This number describes enrollments at the Columbus campus; enrollments at regional campuses in Lima, Mansfield, Marion, Newark, and Wooster are not counted.

3. VERY, VERY, VERY LONG TITLE THAT FLOWS INTO A SECOND LINE FOR THE SAKE OF EXAMPLE

Notice that the title of this section is long - much longer than the others. When you have long section titles, this template takes care of double spacing the lines in the title. If the title is long to fit in the table of contents, the template will single space the title.

3.1 Yet Another Table

Another table is placed here to show the effect of having tables in multiple sections. The list of tables should still double space between table titles, while single spacing long table titles.

Dates	Attendance
August 8-10, 2008	3,523
August 14-16, 2009	4,003
July 9-11, 2010	5,049
August 5-7, 2011	6,891
August 10-12, 2012	9,464
August 16-18, 2013	11,077
July 18-20, 2014	14,686
July 31-August 2, 2015	18,411

Table 3.1: San Japan attendance. Data is taken from [1]. I intentionally make the title of this table long so the single space effect is seen in the list of tables.

You may be wondering why San Japan was chosen. There are a few reasons as to why I did this:

1. It is one of the fastest-growing anime conventions in Texas.
2. Filler.

3. I wanted a good variety of table examples.
4. Because conventions are cool.

The *enumerate* environment was used to generated an ordered list above.

3.2 Section Test Example

We insert another figure here, just for kicks.

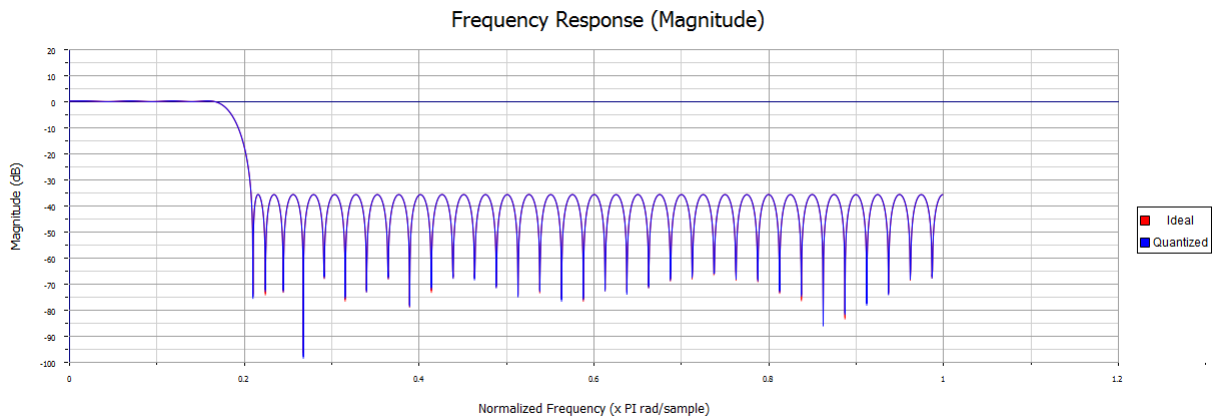


Figure 3.1: A low pass filter design.

3.2.1 Filler, Filler, Filler

This section has filler text.

3.2.2 Subsection Test Example

Test subsection for TOC display

3.2.3 Subsection Test Example 2

Test subsection for TOC display

3.2.4 Section Summary

This holds the summary.

3.3 Section Test Example 3

Test section for toc display only

3.3.1 Subsection Test 1

Test subsection for toc display only.

3.3.2 Subsection Test 2

Test subsection for toc display only.

4. SUMMARY AND CONCLUSIONS

****Some text/figure here****

4.1 Challenges

Section here is to test toc display only.

4.2 Further Study

Section here is to test toc display only.

REFERENCES

- [1] “Animecons.com - Anime Conventions and Guests.” Web, 2015.
- [2] N. Carothers, *Real Analysis*. Cambridge University Press, 2000.
- [3] A. Einstein, “Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies],” *Annalen der Physik*, vol. 322, no. 10, pp. 891–921, 1905.
- [4] C. F. Barnes and R. L. Frost, “Residual vector quantizers with jointly optimized code books,” *Advances in Electronics and Electron Physics*, vol. 84, pp. 1–59, 1992.
- [5] “Results - Arcadia Festival of Bands.” Web, November 2011.

APPENDIX A

FIRST APPENDIX

Text for the Appendix follows.



Figure A.1: TAMU figure

APPENDIX B

BIBLIOGRAPHY INFORMATION

As previously mentioned, one program that can be used to organize references is [JabRef](#). While a tutorial of how to use **JabRef** is beyond the scope of this template, a brief discussion of how to use **BibTeX** follows.

B.1 BibTeX

After you have installed **JabRef**, or any citation manager of your choosing that is compatible with **BibTeX**, you must save a **BibTeX** database. This database file will contain all the information **BibTeX** requires to generate your bibliography. An example .bib file is include in this template that is named ‘myReference.bib’. The first entry of that file is shown below.

```
@Article{Barn-JORVQ,  
  author = {Christopher F. Barnes and Richard L. Frost},  
  title   = {Residual Vector Quantizers with Jointly Optimized Code Books},  
  journal = {Advances in Electronics and Electron Physics},  
  year    = {1992},  
  volume  = {84},  
  pages   = {1--59},  
}
```

All of the entries in the entry are very self-explanatory, such as author and title, however, arguably the most important part of the entry is the key. The key is the first entry after @Article, which is Barn-JORVQ in this example. This is the key you will use in any cite commands for references, e.g.,

```
\cite{Barn-JORVQ}
```

Depending on the citation style that is used, there may be different cite commands for different types of in-text citations. It is important to know which commands must be used with the citation style you are using.

B.2 Compiling with BibTeX

When compiling your L^AT_EX document, it is also important to remember to compile it twice to ensure that all equation, fig, table, etc. cross-references have updated correctly. However, when using citations from a .bib file in your document, the process is a little longer. To ensure that your bibliography generates correctly, one must run pdfLaTeX, then BibTeX, then pdfLaTeX twice. This will ensure that all the citations and cross-references are updated correctly. If you are using a program such as **MikTeX** or **ProTeXt**, this may be the default compilation method. However, if you **TeXShop** on a Mac, you must change the compiler, next to the Typeset button, from LaTeX to BibTeX, and back to compile properly. If compiling from command line, the sequence would be:

```
pdflatex TAMU_Thesis_Main.tex
bibtex TAMU_Thesis_Main.aux
pdflatex TAMU_Thesis_Main.tex
pdflatex TAMU_Thesis_Main.tex
```

Be sure to check the output for any errors. If question marks (?) appear in any location where a reference should be, there was an issue with the compilation. Make certain that the key used in the cite command matches the corresponding references in the .bib file.