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# Introduction to LyX

The files used in this section are `first.lyx`, `first.pdf`, `master.zip`, `biometrics-lyx-example.zip`, and `nuthesis-lyx.zip`.

## What is LyX?

LyX uses L<sup>A</sup>T<sub>E</sub>X to create its documents but through a nice Word-like GUI. Therefore, LyX essentially provides the user friendly interface of Word while also producing great looking documents. The software package is based on the “what you see is what you mean” (WYSIWYM) philosophy of typing documents. Thus, the content on a computer screen is not exactly like it would appear in a printed or PDF format. This content is eventually translated based on a set of style choices to the printed or PDF format.

LyX is available for free at <http://www.lyx.org/Download>. In order for LyX to run properly, L<sup>A</sup>T<sub>E</sub>X (MikT<sub>E</sub>X) needs to be installed as well. LyX can be installed separately from L<sup>A</sup>T<sub>E</sub>X or both can be installed simultaneously through a program available on the LyX website.

There are other software packages like LyX with the most popular of these being Scientific Word (<http://www.mackichan.com>). Unfortunately, these other packages are not free.

## Hello World!

The `first.lyx` file can be used to create the `first.pdf` document. This PDF is very similar but not exactly the same to the corresponding document in the L<sup>A</sup>T<sub>E</sub>X notes.

Below is the PDF document generated by LyX.

first.pdf - Adobe Acrobat Reader DC

File Edit View Window Help

Home Tools Document 1 / 2 100% Sign In

Bookmarks

- 1 Introduction
- 2 Background
  - 2.1 Notation
  - 2.2 Model
- 3 Proposed methodology
- 4 Simulation study
- 5 Discussion

Hello World!

Chris Bilder

April 7, 2016

## 1 Introduction

This section describes why my new statistical method is soooo important.

## 2 Background

### 2.1 Notation

Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ .

Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ .

### 2.2 Model

Important equation:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} \exp(-(y - \mu)^2 / 2\sigma^2)$$

Another important equation:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(y-\mu)^2}{2\sigma^2}}$$

## 3 Proposed methodology

8.50 x 11.00 in

Below is what the document looks like in LyX:

LyX: C:\chris\unl\Dropbox\NEW\STAT850\LyX\LyX\_intro\first.lyx

File Edit View Insert Navigate Document Tools Help

Section

Outline

Table of Contents

Filter:

1 Introduction

2 Background

2.1 Notation

2.2 Model

3 Proposed metho...

4 Simulation study

5 Discussion

# Hello World!

Chris Bilder

April 7, 2016

## 1 Introduction

This section describes why my new statistical method is soooo important.

## 2 Background

### 2.1 Notation

Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ .

Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ .

**Note**

Example LyX comment: I duplicated the sentence like in the LaTeX example. There are no differences to how I wrote the mathematical parts though.

**Comment** Example LaTeX comment

### 2.2 Model

Important equation:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} \exp(-(y - \mu)^2 / 2\sigma^2)$$

Another important equation:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(y-\mu)^2}{2\sigma^2}}$$

## 3 Proposed methodology

An environment involving lists:

1. First item
2. Second item

A	B
C	D

## 4 Simulation study

In Section Ref: sec:Proposed-met..., we showed that our proposed methods will change the statistical world as  $n \rightarrow \infty$ . Now we will show the same is true for a fixed sample size of  $n$ .

LaTeX Source

Preview source code for paragraph 3

```
\section{Introduction}
```

Format: Default

Current Paragraph

Automatic update

Update

More of the L<sup>A</sup>T<sub>E</sub>X source preview:

LaTeX Source

```

\begin{document}

\title{Hello World!}

\author{Chris Bilder}

\date{April 7, 2016}

\maketitle

\section{Introduction}

This section describes why my new statistical method is soooo important.

\section{Background}

\subsection{Notation}

Suppose  $Y_i$  for  $i=1, \dots, n$  is a random sample from a normal
population with mean  $\mu$  and variance  $\sigma^2$ .

Suppose  $Y_i$  for  $i=1, \dots, n$  is a random sample from a normal
population with mean  $\mu$  and variance  $\sigma^2$ .

\begin{comment}
Example \LaTeX{} comment
\end{comment}

\subsection{Model}

Important equation:
\{
f(y)=\frac{1}{\sigma\sqrt{2\pi}}\exp\left(\frac{(y-\mu)^2}{2\sigma^2}\right)
\}

Another important equation:
\{
f(y)=\frac{1}{\sigma\sqrt{2\pi}}e^{\frac{(y-\mu)^2}{2\sigma^2}}
\}

\section{Proposed methodology\label{sec:Proposed-methodology}}

An environment involving lists:
\begin{enumerate}
\item First item
\item Second item
\end{enumerate}
\begin{tabular}{|c|c|c|}
\hline
A & B & \tabularnewline
\hline
\hline
C & D & \tabularnewline
\hline
\end{tabular}

\section{Simulation study}

In Section \ref{sec:Proposed-methodology}, we showed that our proposed
methods will change the statistical world as  $n \rightarrow \infty$ .
Now, we will show the same is true for a fixed sample size of  $n$ .

\section{Discussion}

In our paper, we showed that ...
\end{document}

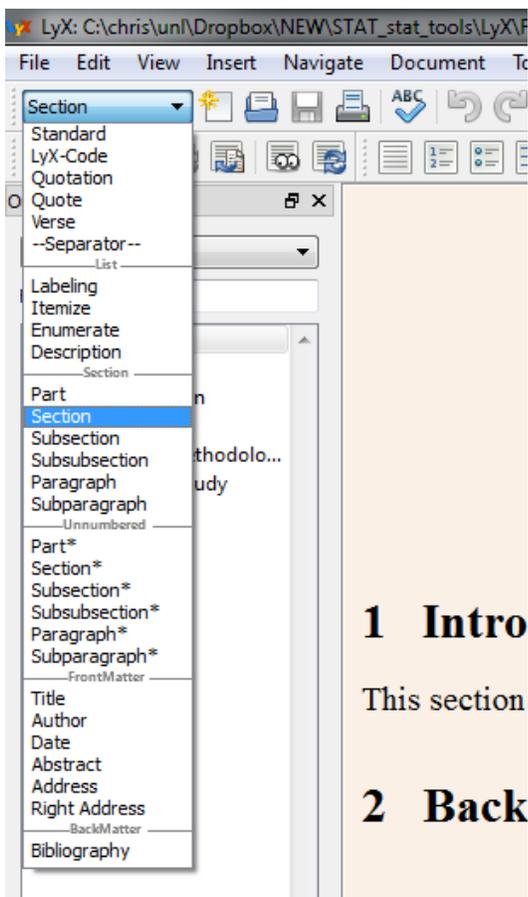
```

Format: Default  
Complete Source  
 Automatic update  
Update

Automatic save done.

## Tour of the LyX document

1.  $\text{\LaTeX}$  code:  $\text{\LaTeX}$  code can be viewed simultaneously with the regular text by examining the  $\text{\LaTeX}$  source window. This window is opened by selecting `VIEW > VIEW SOURCE`. Generally, I do not look at this window unless something is not working correctly. Note that you can NOT change any of the  $\text{\LaTeX}$  code shown in the window. This is kind of disappointing, and it differentiates LyX from many web page editors like Dreamweaver or FrontPage.
2. Spellchecking: Misspellings are underlined by a red dashed line. This highlighting may not be turned on by default. If it is not, select `TOOLS > PREFERENCES... > LANGUAGE SETTINGS > SPELLCHECKER` and select the “Spellcheck continuously” box.
3. Environment names: These are given in a drop down menu shown in the upper left corner.



Only those environments available for a particular document class will be shown. “Section” is highlighted because the cursor was on the Section 1 title when I obtained this screened capture. If I moved the cursor down one line to “regular” text, I would be in the “Standard” environment. I recommend moving the cursor around to other parts of the text so that you can see the different environments. Note that equations and tables will not be shown as part of a math or tabular environment in the drop down menu.

4. Equations: LyX puts all equations into their own “boxes” with highlighted red corners. Below is what a box looks like for the first  $f(y)$  equation:

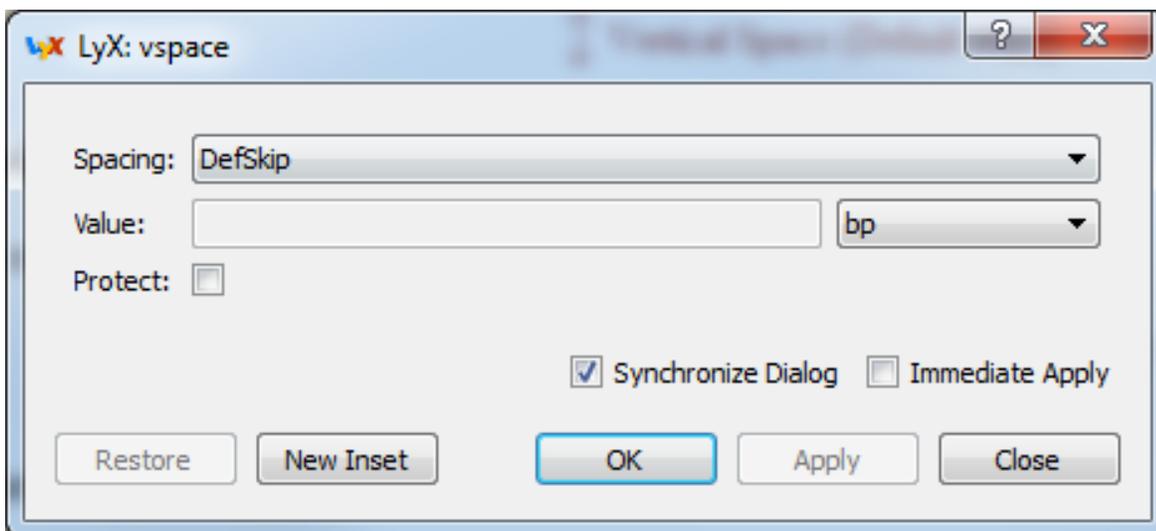
The screenshot shows the LyX interface. The top window displays a document with a section titled "2.2 Model". Below the title, there is a text input field labeled "Important equation:" and another labeled "Another important equation:". A red-bordered box highlights the first equation input field, which contains the mathematical expression  $f(y) = \frac{1}{\sigma\sqrt{2\pi}} \exp((y-\mu)^2 / 2\sigma^2)$ . Below the document window, a "LaTeX Source" window shows the corresponding LaTeX code: `\[ f(y)=\frac{1}{\sigma\sqrt{2\pi}}\exp((y-\mu)^2/2\sigma^2) \]`. At the bottom, there are two toolbars: the top one contains mathematical symbols like  $\Sigma$ ,  $\frac{1}{x}$ ,  $\exp$ ,  $\tan$ ,  $\int$ ,  $\nabla$ ,  $\alpha$ ,  $\leftarrow$ ,  $\leftarrow\leftarrow$ ,  $\pm$ ,  $\leq$ ,  $\leq\leq$ ,  $\neq$ ,  $\dots$ , and  $F$ ; the bottom one contains symbols like  $\frac{1}{x}$ ,  $\sqrt{x}$ ,  $\sqrt[n]{x}$ ,  $\frac{a}{b}$ ,  $\Sigma$ ,  $\int$ ,  $\Pi$ ,  $()$ ,  $[]$ ,  $\{\}$ ,  $||$ , a grid, a table, and a pi symbol. The status bar at the bottom indicates "Type: equation".

The math toolbars at the bottom of the screen provide a convenient point-and-click interface for entering equations. Alternatively, you can type L<sup>A</sup>T<sub>E</sub>X’s math code in the equation box, and LyX will convert it to its corresponding symbol. For example, `\alpha` will be immediately converted to  $\alpha$  after you press the `<SPACE>`, `<TAB>`, `<RIGHT ARROW>`, or `<ENTER>` keys.

To insert new equations, select `INSERT > MATH > INLINE FORMULA` for equations that appear in the normal flow of

- text. Alternatively, you can select the INSERT MATH icon ( $\Sigma$  in the standard toolbar). Note that this icon is different from the “toggle math toolbar” icon also contained in the standard toolbar. For displayed equations, select INSERT > MATH > DISPLAY FORMULA. One can change back and forth from an inline to a display formula by selecting  $\equiv$  on the math toolbar.
5. Inserting comments: LyX has its own comments separate from L<sup>A</sup>T<sub>E</sub>X comments. LyX comments are inserted through INSERT > NOTE > LyX NOTE ( $\text{E}$  in the extra toolbar), and these comments are highlighted in yellow. L<sup>A</sup>T<sub>E</sub>X comments are inserted through INSERT > NOTE > COMMENT, and they are outlined in red. Both types of comment boxes can be minimized.
  6. Inserting blank lines or spaces: In Word, you can insert a large number of blank lines by simply pressing the <ENTER> key a large number of times. In LyX, the same process only leads to one new temporary line. If you do not actually type anything on the line before moving to a different part of the document, the blank line is removed.

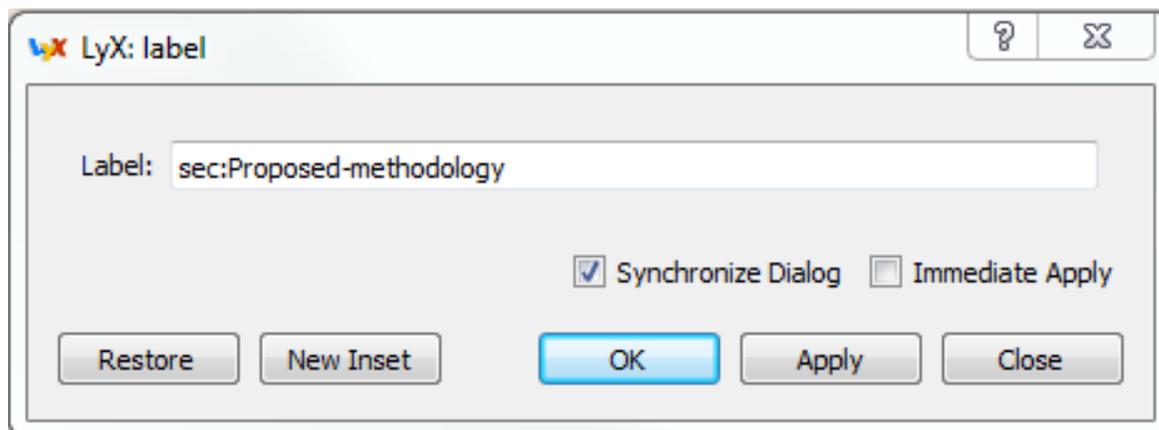
To insert permanent empty vertical space, select INSERT > FORMATTING > VERTICAL SPACE... to bring up the following window:



The spacing drop down menu provides a number of different types of vertical spaces. These vertical spaces are defined specifically by  $\text{\LaTeX}$ .

Similarly, a large number of spaces can be entered in Word by simply pressing the space bar a large number of times. In LyX, this does not work. Only one space can be inserted between words (unless you are using a program listing, to be discussed later). To insert a longer blank space, select **INSERT > FORMATTING > PROTECTED SPACE**. Also, **INSERT > FORMATTING > HORIZONTAL SPACE** can be used in a similar manner.

7. Paragraph symbols: Each complete set of text ends with a paragraph symbol. This symbol is automatically inserted following a  $\langle\text{ENTER}\rangle$ . If these symbols are not showing up, select **TOOLS > PREFERENCES > LOOK & FEEL > DISPLAY** and check the **MARK END OF PARAGRAPHS** box.
8. Cross-references: In order to reference Section 3, I first inserted a label for this section. This was done by positioning my cursor at the end of the Section 3 title and selecting **INSERT > LABEL** to bring up the following window:

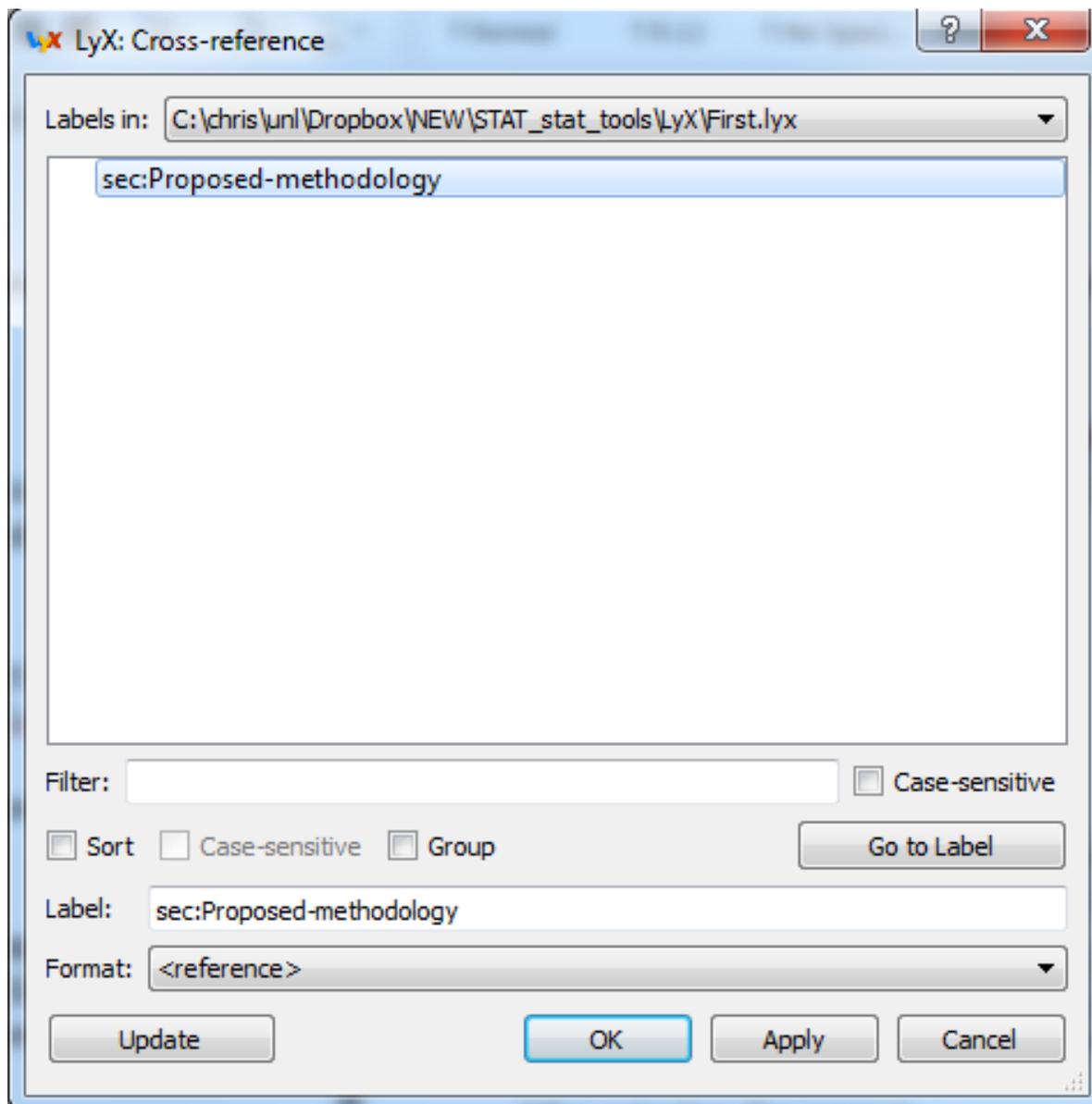


LyX suggests a name for it, which I decided to use by selecting **OK**. Note that the corresponding  $\text{\LaTeX}$  code given by LyX is

```
\section{Proposed methodology}
\label{sec:Proposed-methodology}}
```

which is essentially the same as we used for the L<sup>A</sup>T<sub>E</sub>X document earlier.

To reference this label, I went to the appropriate location in Section 4 and selected INSERT > CROSS-REFERENCE... (select  in the extra toolbar) to bring up the following window:

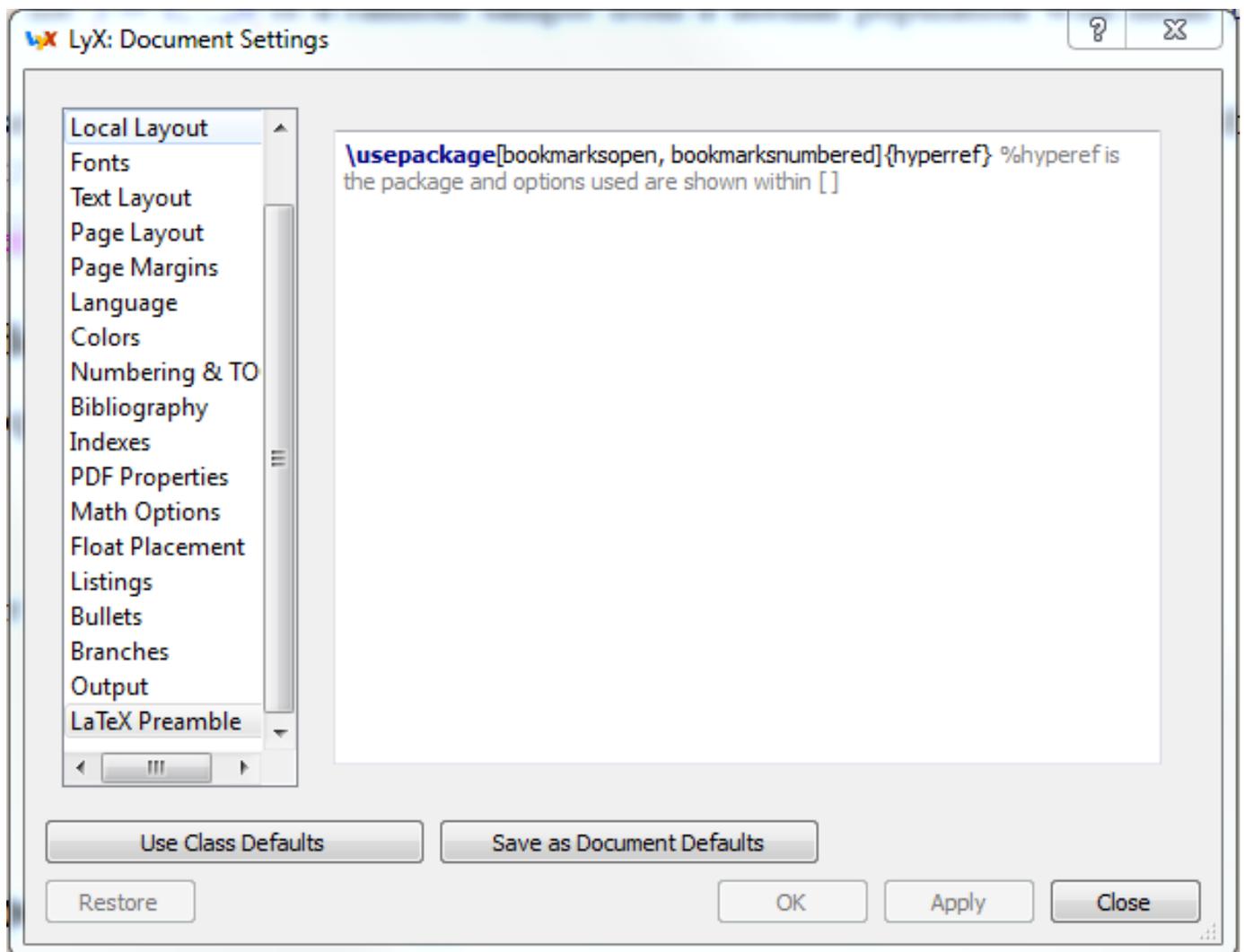


After selecting the correct label, I clicked on OK to reference it. On your own, examine the FORMAT drop down menu to see the various options for cross-referencing.

Both the label and the cross-reference appear as gray boxes in LyX. These boxes can be clicked on to open the same windows as shown above. This can be helpful if you want to

make changes to the label or reference.

9. Inserting tables: Select **INSERT > TABLE**, select the number of rows and columns, and then select **OK** to create a table. Alternatively, you can select the “insert table” icon  from the standard toolbar. The look of the table can be changed by right clicking inside of the table to bring up a shortcut menu and selecting **MORE...**. Available icons on the table toolbar can also be selected to change aspects of the table.
10. Preamble: The original L<sup>A</sup>T<sub>E</sub>X document used the **hyperref** package specified in the preamble. This enabled highlighted and clickable references in the PDF while also opening a list of bookmarks by default. The preamble can be accessed here by selecting **DOCUMENT > SETTINGS > L<sup>A</sup>T<sub>E</sub>X PREAMBLE**:



I simply typed the exact same code as in the  $\text{\LaTeX}$  document. Alternatively, for `hyperref`, LyX now includes a way to automatically include its use. Select `DOCUMENT > SETTINGS... > PDF PROPERTIES` and check the `USE HYPERREF SUPPORT` box.

The document class is found by selecting `DOCUMENT > SETTINGS... > DOCUMENT CLASS`.

## *Creating a PDF*

To create a PDF, select `FILE > EXPORT >  $\text{\LaTeX}$  (PDFLATEX)` or the corresponding “view” icon  in the view/update toolbar. This will create the PDF document and open it into the default PDF viewer. Note that it will NOT automatically save the PDF into the folder where the `.lyx` file is located. To save the PDF, simply save it as you would any other PDF file (in Adobe Acrobat, select `FILE > SAVE AS`). If you make changes to the LyX document, you can select the update icon  in the view/update toolbar to see the new version of the PDF.<sup>1</sup> LyX will automatically close the previous PDF file and open the new one.

When LyX creates a PDF, it sends the  $\text{\LaTeX}$  code to MikTeX to compile it. This is why MikTeX (or some other version of  $\text{\LaTeX}$ ) needs to be on a computer. You can view the log file generated by  $\text{\LaTeX}$  through selecting `DOCUMENT >  $\text{\LaTeX}$  LOG`. This can be useful if LyX is unable to produce a PDF and you want to figure out why. Note that the `.log` file and other files created when compiling a  $\text{\LaTeX}$  document directly are not put into the folder where the LyX document is located.

$\text{\LaTeX}$  code for a LyX document can be exported to a file. Select `FILE > EXPORT >  $\text{\LaTeX}$  (PLAIN)`. The  $\text{\LaTeX}$  file can be useful when a journal requires the `.tex` file.  $\text{\LaTeX}$  files can also be

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<sup>1</sup>Recent changes to Adobe Acrobat may not allow this to work. A discussion is available at <http://tex.stackexchange.com/questions/243899/lyx-view-pdflatex-does-not-display-automatically-in-acrobat-pro-dc> and <http://www.lyx.org/trac/ticket/9512>. I followed the suggestion of installing a new `pdfview.exe` file to kind of solve the problem.

imported as well. Select FILE > IMPORT > L<sup>A</sup>T<sub>E</sub>X (PLAIN) and browse to the .tex file. Note that the importation is not perfect. There will be times that LyX can not figure out how the L<sup>A</sup>T<sub>E</sub>X code corresponds to a particular aspect of LyX, so it will create a L<sup>A</sup>T<sub>E</sub>X code box containing this code (these boxes will be discussed later). As an example, I imported the First.tex file from the L<sup>A</sup>T<sub>E</sub>X notes. Below is the result in LyX:

## 1 Introduction

This section describes why my new statistical method is soooo important.

## 2 Background

### 2.1 Notation

Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ .

Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ . **%Alternative to...**

Example of using a shortcut command: `\ybar`

### 2.2 Model

Important equation:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} \exp(-(y - \mu)^2 / 2\sigma^2)$$

Another important equation:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(y-\mu)^2}{2\sigma^2}}$$

## 3 Proposed methodology

**label for section** An environment involving lists:

1. First item
2. Second item

## 4 Simulation study

In Section **Ref: label for section**, we showed that our proposed methods will change the statistical world as  $n \rightarrow \infty$ . Now, we will show the same is true for a fixed sample size of  $n$ .

**float: Table**

<b>%l is for left ...</b> A	B	⋮
C	D	⋮

## 5 Discussion

In our paper, we showed that ...

Problems with the importation are:

- The `\newcommand` part for `\ybar` did not work
- There is no title, author, or date given.

## Resources for LyX

- LyX has a nice website. I have found its wiki at <http://wiki.lyx.org> to be very helpful, including its example files at <http://wiki.lyx.org/Examples/Examples>.
- LyX comes with many different manuals accessible through HELP in LyX. When I first started learning how to use LyX, I printed off the Introduction, Tutorial, User's Guide, Embedded Objects, Math, and Customization manuals, and put them all into one binder. Through reading ALL of the manuals, I obtained a lot of good useful information. I still keep this binder near my computer so that I can access it quickly.
- LyX is widely used (despite most statisticians not knowing about it?), so Google searches can be quite helpful. For example, many blogs discuss how to use LyX.

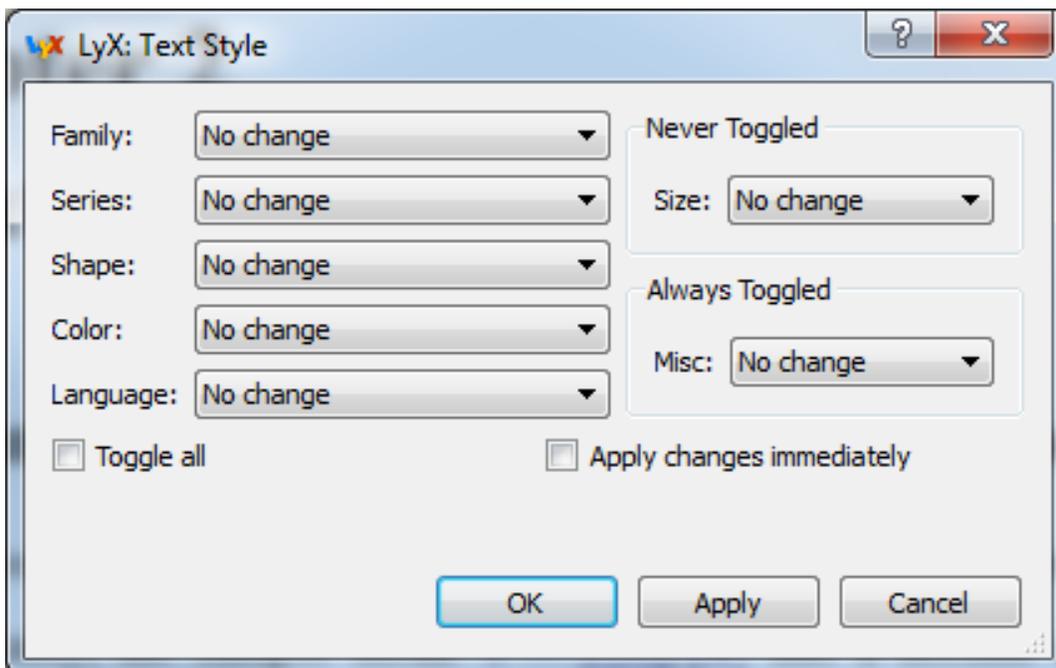
## Master-child example

The purpose of this section is to provide more specific details for using LyX. The book document class will be used for these documents.

1. Text styles: There are few options for text styles. Below are some examples given in the LyX document and in its corresponding PDF:

Family is Roman	Family is Roman
<b>Family is Sans Serif</b>	Family is Sans Serif
Family is Typewriter	Family is Typewriter
Color is red	Color is red
TOGGLE NOUN	TOGGLE NOUN
<i>Toggle emphasis</i>	<i>Toggle emphasis</i>

To change a text style for a phrase, highlight the phrase of interest. Select EDIT > TEXT STYLE > CUSTOMIZED or the text style icon  in the extra toolbar. The following window will open:



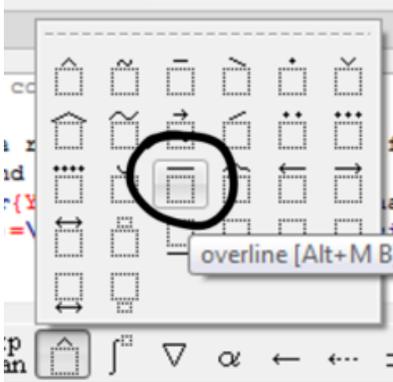
Select a desired value in one of the drop down menus.

If you need to re-apply a previously selected text style to a new phrase, the easiest way is to highlight the phrase and select the apply last icon  from the standard toolbar. Also in the standard toolbar, there are separate icons for small caps (Toggle noun ) and italicization (Toggle emphasis .

2. Nested elements and summation symbols in equations: Suppose we are interested in the inline equation of  $\bar{y} = \sum_{i=1}^n y_i/n$ .

The corresponding equation in LyX is entered as follows:

- (a) Create an inline formula by selecting  $\Sigma$  from the standard toolbar
- (b) Select the overline icon from the math toolbar



- (c) Type a Y. Notice how LyX indicates the “nesting” of Y inside the overline area:



- (d) Press the right arrow key to take the cursor outside of the overline area. The nesting symbols are no longer present.
- (e) Type “=” and select the summation icon  $\Sigma$  on the math toolbar.
- (f) For the “ $i$  =” part, insert a subscript by typing “\_i=” or select from the  $\square$  math toolbar and type “i=”. Move out of the subscript nesting part by selecting the right arrow key.
- (g) For the “ $n$ ” part, type “^n” or select  $\square$  from the math toolbar and type “n”. Move out of the superscript nesting part by selecting the right arrow key.
- (h) Type “Y\_i” to obtain  $Y_i$ .

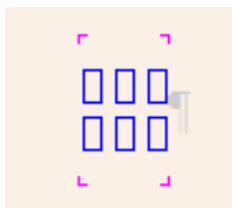
(i) Type “/n”.

LyX will automatically put the summation indices as a subscript and superscript. If instead the equation was a displayed formula, LyX would put the “ $i =$ ” below the sigma and “ $n$ ” above the sigma.

- Equation numbering and referencing: While the cursor is inside a displayed formula, select EDIT > MATH > NUMBER WHOLE FORMULA. Alternatively, right click on the equation and select NUMBER WHOLE FORMULA. The equation numbers given in LyX will may change and look odd during the editing of a document. When the document is compiled, they will be correct.

To reference this equation number in the text, you need to add a label as we did earlier to cross-reference a section. While the cursor is inside an equation, select INSERT > LABEL and type a label in the corresponding window. Alternatively, right click on the equation and select EQUATION LABEL. The equation is then cross-referenced by putting the cursor in the desired location and selecting INSERT > CROSS-REFERENCE. From the window that appears, select the equation label.

- Multiline equations: When you are showing a mathematical expression is true or performing a formal proof, you often start with one equation and show that it is equal to another equation through multiple lines of expressions. This can be done in LyX by creating a three-column matrix structure. The easiest way is to create a displayed equation and then press <CTRL><ENTER> simultaneously on the keyboard. This will create the following structure for an equation:



The middle column is usually where the equal sign is placed. Below is an example:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(y-\mu)^2}{2\sigma^2}} \quad (50,\text{eq:Equation-label3})$$

$$\square = \frac{1}{\sigma\sqrt{2\pi}} \exp((y - \mu)^2 / 2\sigma^2) \quad (51,\text{eq:Equation-label4})$$

Notice that I have numbered each line of the equation using methods described in the last bullet. Additional lines can be added to this equation by pressing <CTRL><ENTER> again or by selecting  from the math toolbar.

There are a number of different forms for these multiline equations. You can access them through selecting INSERT > MATH.

5. Do not end a paragraph before a displayed equation: Before a displayed equation in Word, one usually presses the <ENTER> key in order to go down to a new line. This should be avoided in LyX! When you get to the end of some text, immediately enter the equation and change it to a displayed format. If you did press <ENTER> before the displayed equation, extra space will be present in the PDF.

Thus, this is correct (“display formula” = “displayed equation”):

Display formula

$$\bar{Y} = \sum_{i=1}^n Y_i / n$$

and this is not correct:

Display formula

$$\bar{Y} = \sum_{i=1}^n Y_i / n$$

This image show what happens in the PDF with the correct use:

Display formula

$$\bar{Y} = \sum_{i=1}^n Y_i / n$$

and this image shows what happens in the PDF with the incorrect use:

Display formula

$$\bar{Y} = \sum_{i=1}^n Y_i / n$$

where both images are the same magnifications.

6. Floating tables: A floating table is one that is not forced to be at a particular place in a document. Rather, the software package chooses a place close to a desired location.  $\text{\LaTeX}$  does an excellent job with these types of tables.

Select INSERT > FLOAT > TABLE to produce the following:

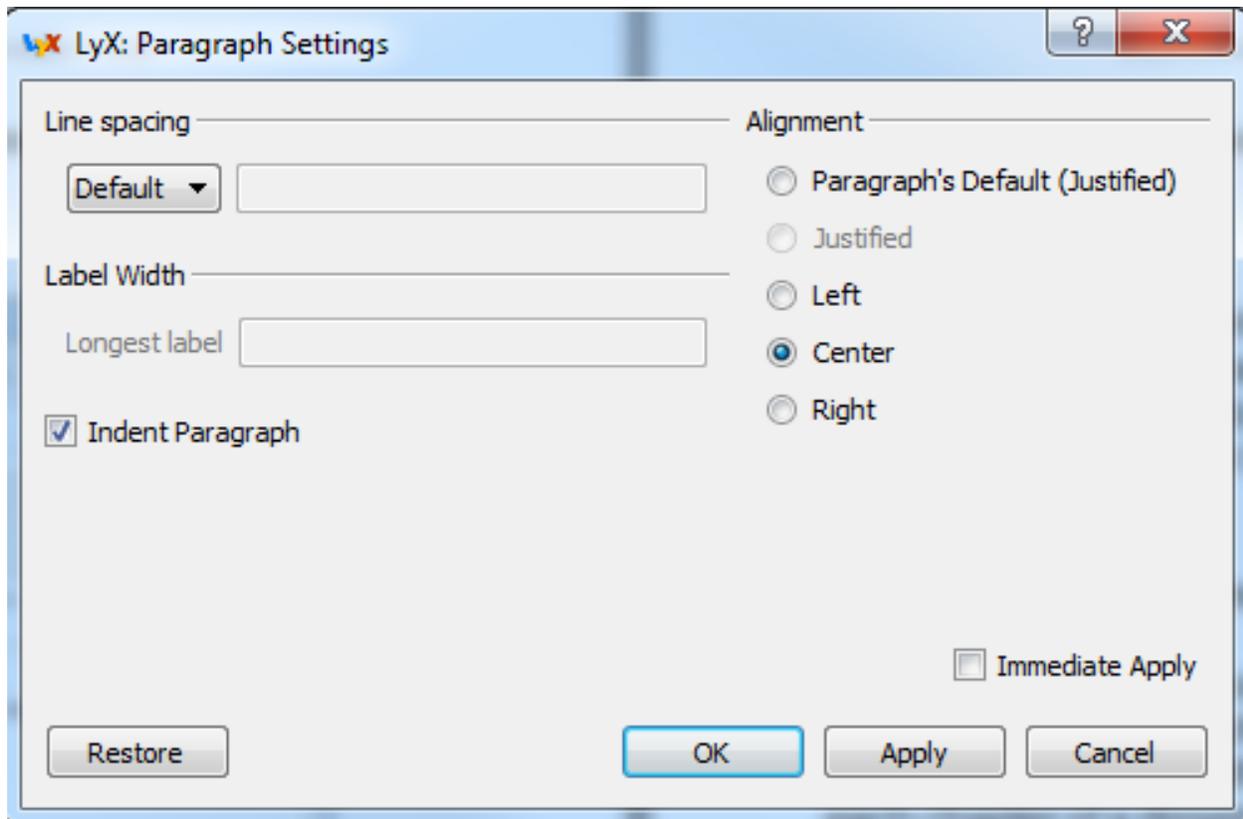
float: Table

Table 2.1: 

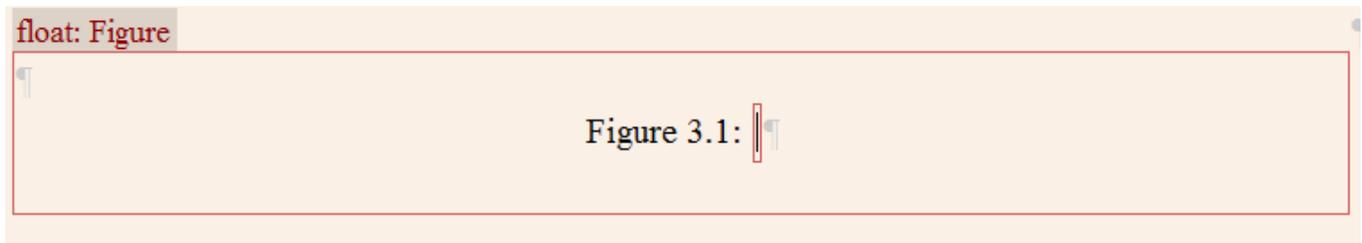
The caption goes next to the table name within the red rectangle. This is also where a label can be place in order to cross-reference the table. After the inner rectangle, a table can be inserted using similar methods as before.

The table can be centered. Next to the outer red rectangle, select the paragraph settings icon  on the extra toolbar

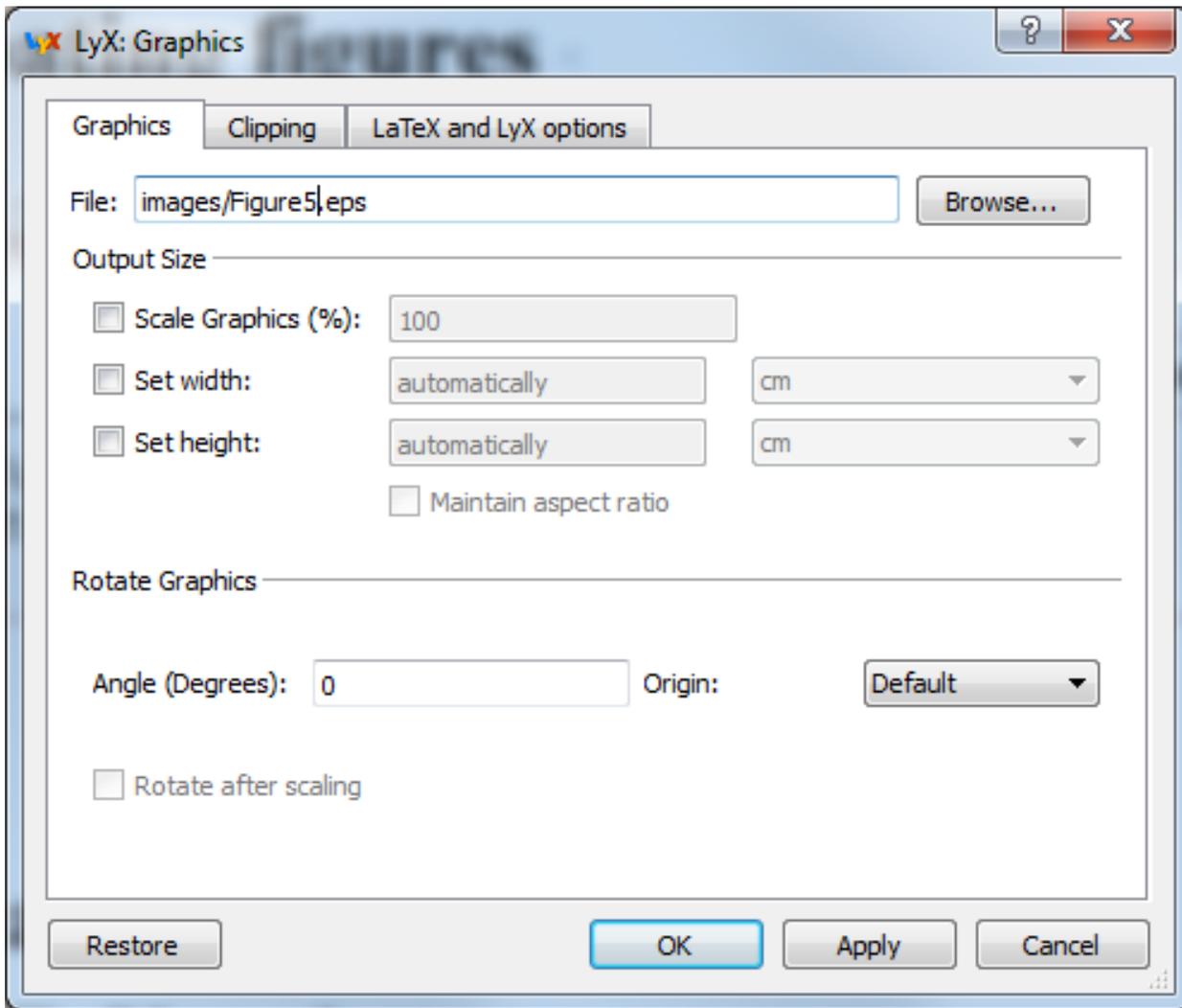
(or right click to bring up a shortcut menu and select PARAGRAPH SETTINGS). Select CENTER under alignment.



7. Floating figures: Select INSERT > FLOAT > FIGURE to produce the following:



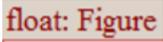
The caption goes next to the figure name within the red rectangle. This is also where a label can be placed to cross-reference the figure. After the inner rectangle, a graphic file can be inserted by selecting INSERT > GRAPHICS. Below is the corresponding graphics window where I browsed to the location of my figure.



Comments:

- When you have a lot of graphic files, it is best to keep them within a separate folder of your child document's folder (child documents are discussed shortly).
- LyX accepts all of the common graphic file types. However, the best looking graphics are in PDF, postscript, or encapsulated postscript files (note that L<sup>A</sup>T<sub>E</sub>X can have problems with these encapsulated postscript files at times). I generally use PDF files, despite using an encapsulated postscript file here.
- You can copy and paste a graphic into LyX in a way somewhat like what is done with Word. After paste is selected, LyX will prompt you for a location to save a file that contains the image. Thus, LyX still will be referring to an

external file for the image.

- Floating figures (and tables) can be minimized in the text by clicking on 
  - If the graphic appears too large in the PDF, select the SCALE GRAPHICS (%) box and change the percentage given.
8. Prevent line indenting: After a displayed formula, you will often not want to indent the text following it. This can be done in a similar manner as with centering tables or figures. Specifically, select the paragraph settings icon  on the extra toolbar (or right click to bring up a shortcut menu and select PARAGRAPH SETTINGS). Uncheck the INDENT PARAGRAPH box.
9. Inserting L<sup>A</sup>T<sub>E</sub>X code: L<sup>A</sup>T<sub>E</sub>X code can be inserted by selecting INSERT > TEX CODE ( in the extra toolbar). A red outlined box will appear in the document where you can type code. For example, below is how I entered a segment of code from first.tex:

## Chapter 5

### LaTeX code

```
Suppose  $Y_i$  for  $i = 1, \dots, n$  is a random sample from a normal population with mean  $\mu$  and variance  $\sigma^2$ .
```

Inserting L<sup>A</sup>T<sub>E</sub>X code into a LyX document is most useful when LyX does not have a way to perform a particular operation or if there is a conflict with a document class or style file. For example, there are a few places in my book where the publisher's style file causes problems when creating a PDF. A specific example is when I need to use L<sup>A</sup>T<sub>E</sub>X code for parts of tables:

float: Table

```
\tabletitle[label]{Salk vaccine clinical trial results; data source is
\citeauthor{Francis1955} (\citeyear{Francis1955}, p.~25)}.
```

	Polio	Polio free	Total	
tab:Ch1: Polio   Note	Vaccine	57	200,688	200,745
	Placebo	142	201,087	201,229
	Total	199	401,775	401,974

10. Code boxes: There are times where you would like to include SAS or R code in a document and use a courier-like font look to distinguish it. One way to do this is through using a program listing box. Select INSERT > PROGRAM LISTING to create the box. Inside the box, you can use the <SPACE BAR> key to line up text as needed (e.g., it's useful for indenting). If a single set of commands extends over multiple lines, LyX can indent all lines after the first.

Below is what code looks like in the LyX document and the PDF. Notice where the end of paragraph symbols are in the document and how this effects code wrapping in the PDF.

Continuing from the last example, below is how the calculations are performed in R:

```
> p.tilde <- (w + qnorm(p = 1-alpha/2)^2 / 2) / (n +
qnorm(p = 1-alpha/2)^2) ¶
> p.tilde ¶
[1] 0.4277533 ¶
¶
> #Wilson C.I. ¶
> round(p.tilde + qnorm(p = c(alpha/2, 1-alpha/2)) *
sqrt(n) / (n + qnorm(p = 1-alpha/2)^2) *
sqrt(pi.hat*(1-pi.hat) + qnorm(p = 1-alpha/2)^2/(4*n)),
4) ¶
[1] 0.1682 0.6873 ¶
¶
> #Agresti-Coull C.I. ¶
> var.ac <- p.tilde*(1-p.tilde) / (n + qnorm(p =
1-alpha/2)^2)¶
> round(p.tilde + qnorm(p = c(alpha/2, 1-alpha/2)) *
sqrt(var.ac), 4) ¶
[1] 0.1671 0.6884
```

After calculating  $\hat{p}$ , we calculate the Wilson and Agresti-Coull intervals through one line of code

Continuing from the last example, below is how the calculations are performed in R:

```
> p.tilde <- (w + qnorm(p = 1-alpha/2)^2 / 2) / (n +
  qnorm(p = 1-alpha/2)^2)
> p.tilde
[1] 0.4277533

> #Wilson C.I.
> round(p.tilde + qnorm(p = c(alpha/2, 1-alpha/2)) *
  sqrt(n) / (n + qnorm(p = 1-alpha/2)^2) *
  sqrt(pi.hat*(1-pi.hat) + qnorm(p =
  1-alpha/2)^2/(4*n)), 4)
[1] 0.1682 0.6873

> #Agresti-Coull C.I.
> var.ac <- p.tilde*(1-p.tilde) / (n + qnorm(p =
  1-alpha/2)^2)
> round(p.tilde + qnorm(p = c(alpha/2, 1-alpha/2)) *
  sqrt(var.ac), 4)
[1] 0.1671 0.6884
```

After calculating  $\tilde{\pi}$ , we calculate the Wilson and Agresti-Coull intervals through

I use a LyX-code environment immediately before the code box to force an indent . Also, I added

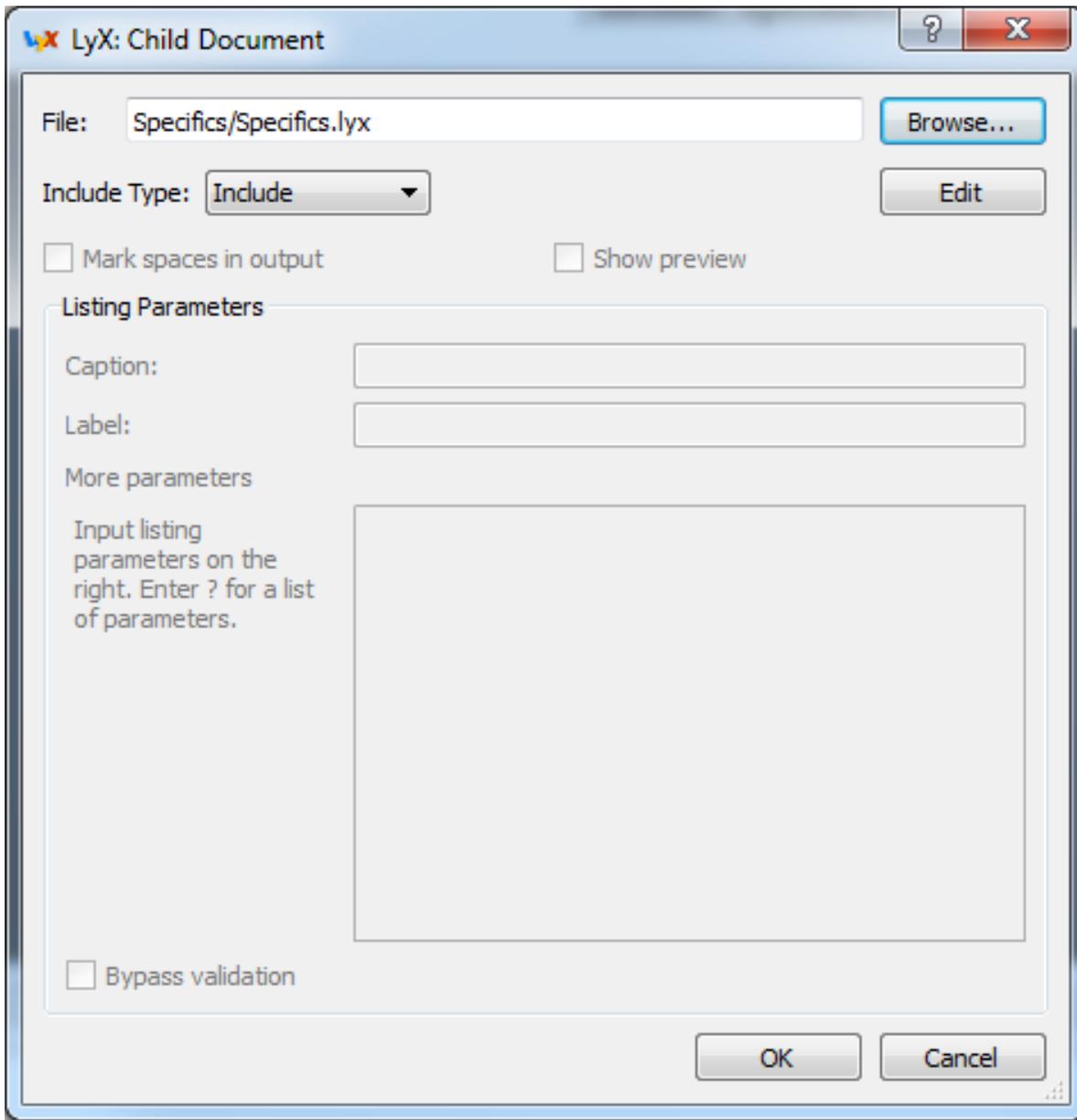
```
\lstset{showstringspaces = false, breaklines =
true, breakatwhitespace = true, basicstyle = {\small
\ttfamily}, xrightmargin = -32pt}
```

to the preamble to achieve other formatting in the PDF. You can also insert these options by using DOCUMENT > SETTINGS > LISTINGS. See [https://en.wikibooks.org/wiki/LaTeX/Source\\_Code\\_Listings](https://en.wikibooks.org/wiki/LaTeX/Source_Code_Listings) for descriptions of the options.

11. Master and child documents: When you are creating a large document, like a book or dissertation, it is helpful to use a

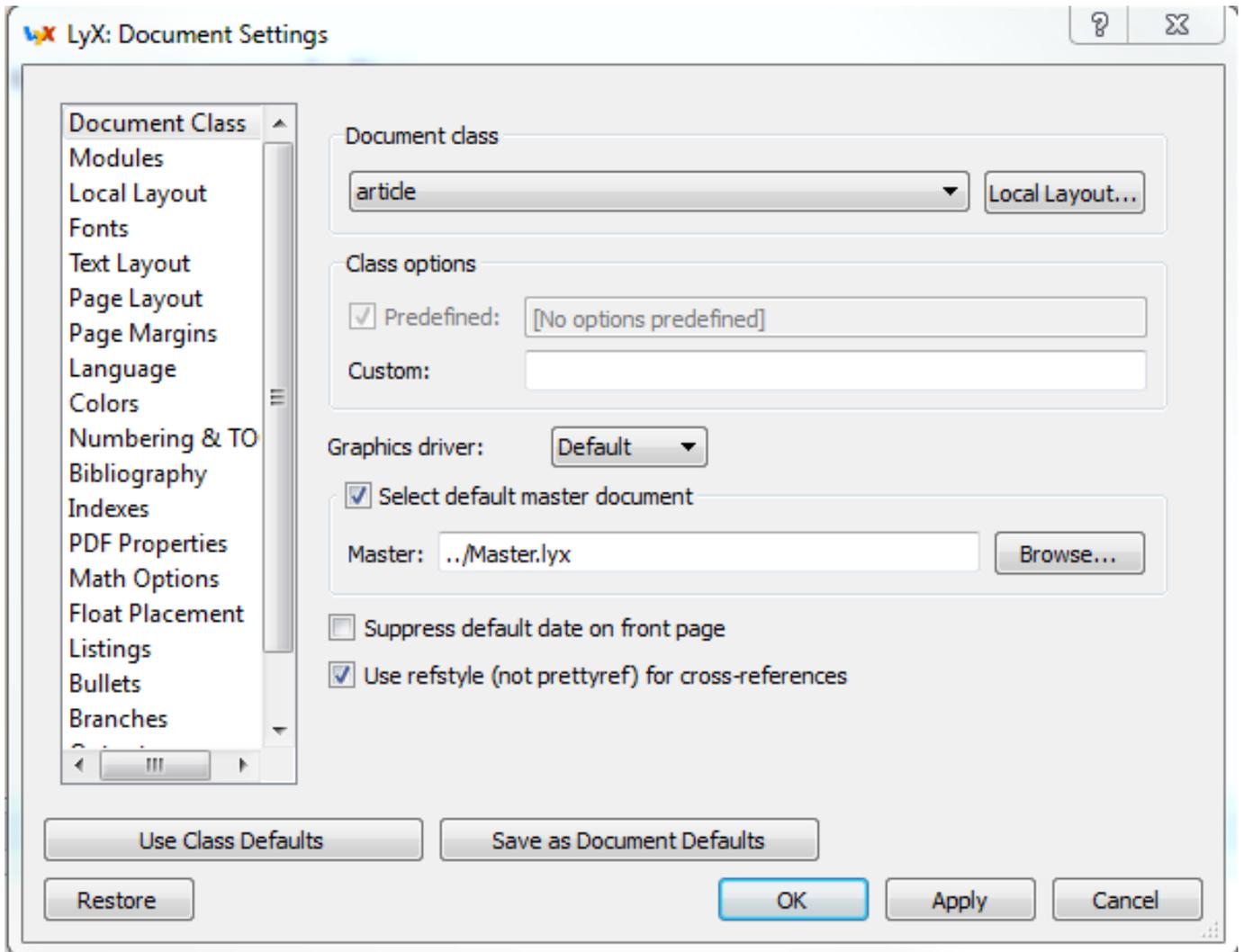
master and child document structure. With respect to a dissertation, each chapter of a dissertation can be a separate *child* LyX document in its own folder (along with any programs or images corresponding to it). In the parent folder, a *master* LyX document can reside that will automatically include all of the child documents. This master document can also contain items like a title page, abstract, table of contents, bibliography, and index.

In my example, I simply have a master named Master.lyx and a child named Specifics.lyx. Child documents can be inserted into a master document by selecting INSERT > FILE > CHILD DOCUMENT in the master document to bring up the window:



and then browsing to the corresponding child document. The INCLUDE option for INCLUDE TYPE will force a page break in a PDF prior to the child document's text. The INPUT option for INCLUDE TYPE will not force a page break.

In the child documents, select DOCUMENT > SETTINGS > DOCUMENT CLASS to bring up the window below:

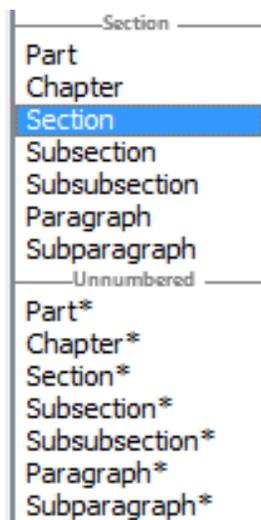


Check the “Select default master document” box and browse to the master document. Note that I entered “../Master.lyx” rather than the actual full folder address on my hard drive. This enables anyone to take the folder structure in my .zip file and use it on their computer without changing the Master folder location.

PDFs can be created from compiling both the master and child document files. However, only the PDF from master document will contain the child documents and any other content that exists in the master document. Note that a child document is supposed to use the master document’s preamble when compiling; however, I have had difficulty at times getting a child document to look correct when it is compiled alone.

12. Table of Contents: Select INSERT > LIST / TOC > TABLE

OF CONTENTS in the master document. All items created in the master and child documents in the “Section” and “Subsection” environments will be displayed. Appendices, bibliographies, and indexes will also be displayed. Those items in the “Unnumbered” environments will not be displayed.



13. Appendix: Select DOCUMENT > START APPENDIX HERE in the master document to create the following:

Appendix

The appendices can be entered into this region. The Chapter environment can be used to number separate appendices just like it is used for regular chapters.

14. Bibliography: There are a few ways to create bibliographies in LyX. I am going to demonstrate the most automated form which uses an external BibTeX references file (.bib) containing all possible paper references that may be included within a document. This .bib file is needed during the L<sup>A</sup>T<sub>E</sub>X compiling process! In fact, if you used L<sup>A</sup>T<sub>E</sub>X directly rather than LyX, you may need to compile your document just for the bibliography itself (select the BibTeX compilation tool) to account for the bibliography.

I will use JabRef (<http://www.jabref.org>) to create a BibTeX file that contains my references. This is one of many

free programs that can be used to create these types of files. Note that you need to have Java installed on your computer in order to use this specific program. You can link the resulting .bib file to your LyX document in order to cite references within the .bib file, and LyX will include in a bibliography only those references actually cited.

To begin, I need some references! Two common places to find references are Google Scholar and the Current Index to Statistics (CIS). For example, I performed a Google Scholar search for my name and obtained the following reference

### Informative retesting

CR Bilder, JM Tebbs, P Chen - Journal of the American Statistical ..., 2010 - Taylor & Francis

In situations where individuals are screened for an infectious disease or other binary characteristic and where resources for testing are limited, group testing can offer substantial benefits. Group testing, where subjects are tested in groups (pools) initially, has been ...

Cited by 18 Related articles All 11 versions Web of Science: 12 Import into BibTeX Save More

Selecting the Import into BibTeX link leads to the following BibTeX code:

```
@article{bild:Tebb:Chen:info:2010,
  title={Informative retesting},
  author={Bilder, Christopher R and Tebbs, Joshua M and
    Chen, Peng},
  journal={Journal of the American Statistical
    Association},
  volume={105},
  number={491},
  pages={942--955},
  year={2010},
  publisher={Taylor & Francis}
}
```

In JabRef, I select the  icon from its toolbar to enter a new reference. By selecting the BibTeX source tab, I can simply copy and paste references into it:

The screenshot shows the JabRef application window. The top part is a table of references. The bottom part is a text editor showing the BibTeX source code for a selected entry.

#	Entrytype	Author	Title	Year	Journal	Owner	Timestamp	Bibtexkey
1	Article	Bilder	Human or Cylon? (G)roup Testing on `B}attl...	2009	Chance			Bild:hum...
2	Article	Bilder et al.	Informative Retesting	2010	Journal o...			Bild: Tebb...
3	Article	Chen et al.	Group (T)esting (R)egression (M)odels with {...	2009	Biometrics			Chen:Te...
4	Article	Loughin and Bilder	On the Use of a Log-rate Model for Survey-w...	2011	Communi...			Loug: Bild...
5	Article					Bilder	2016.04.14	

```

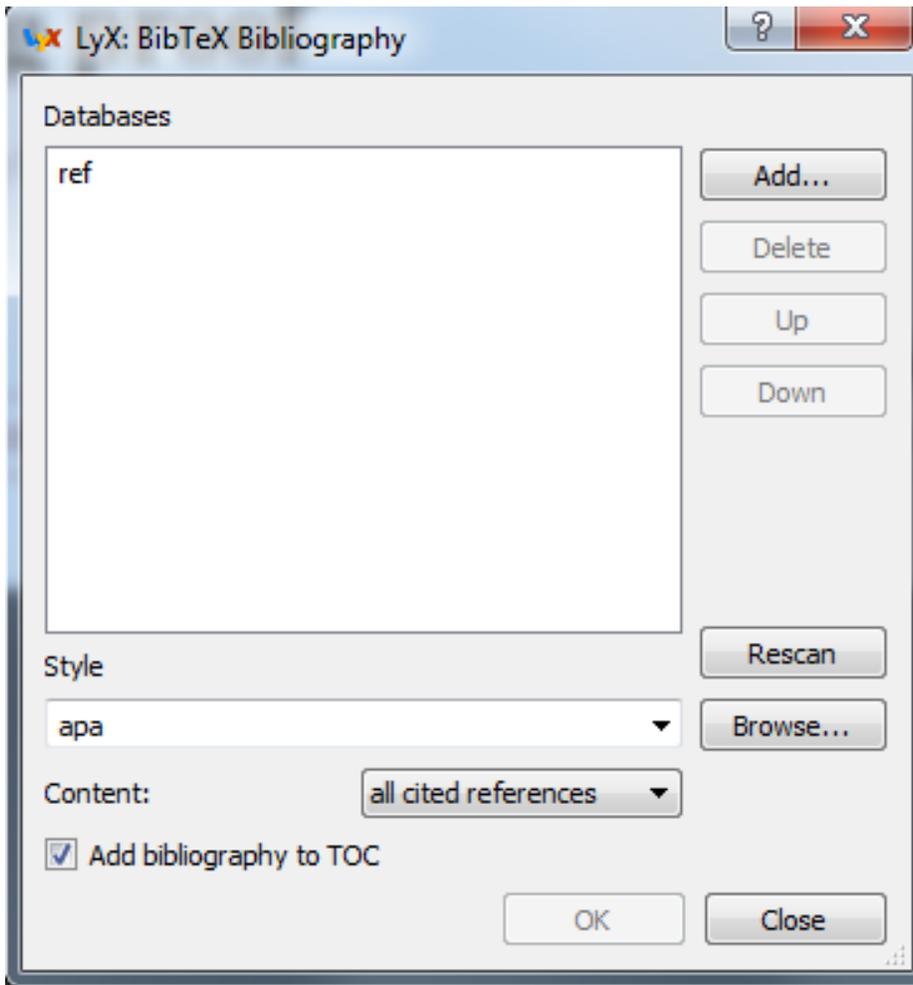
@article{bilder2010informative,
  title={Informative retesting},
  author={Bilder, Christopher R and Tebbs, Joshua M and Chen, Peng},
  journal={Journal of the American Statistical Association},
  volume={105},
  number={491},
  pages={942--955},
  year={2010},
  publisher={Taylor \& Francis}
}

```

You can also import into JabRef a large number of references all at once. All you need is a plain text file containing the `@ARTICLE{ }` syntax that you see from Google Scholar (CIS also provides this as well). Select **FILE > IMPORT INTO NEW DATABASE** within JabRef and browse to the text file.

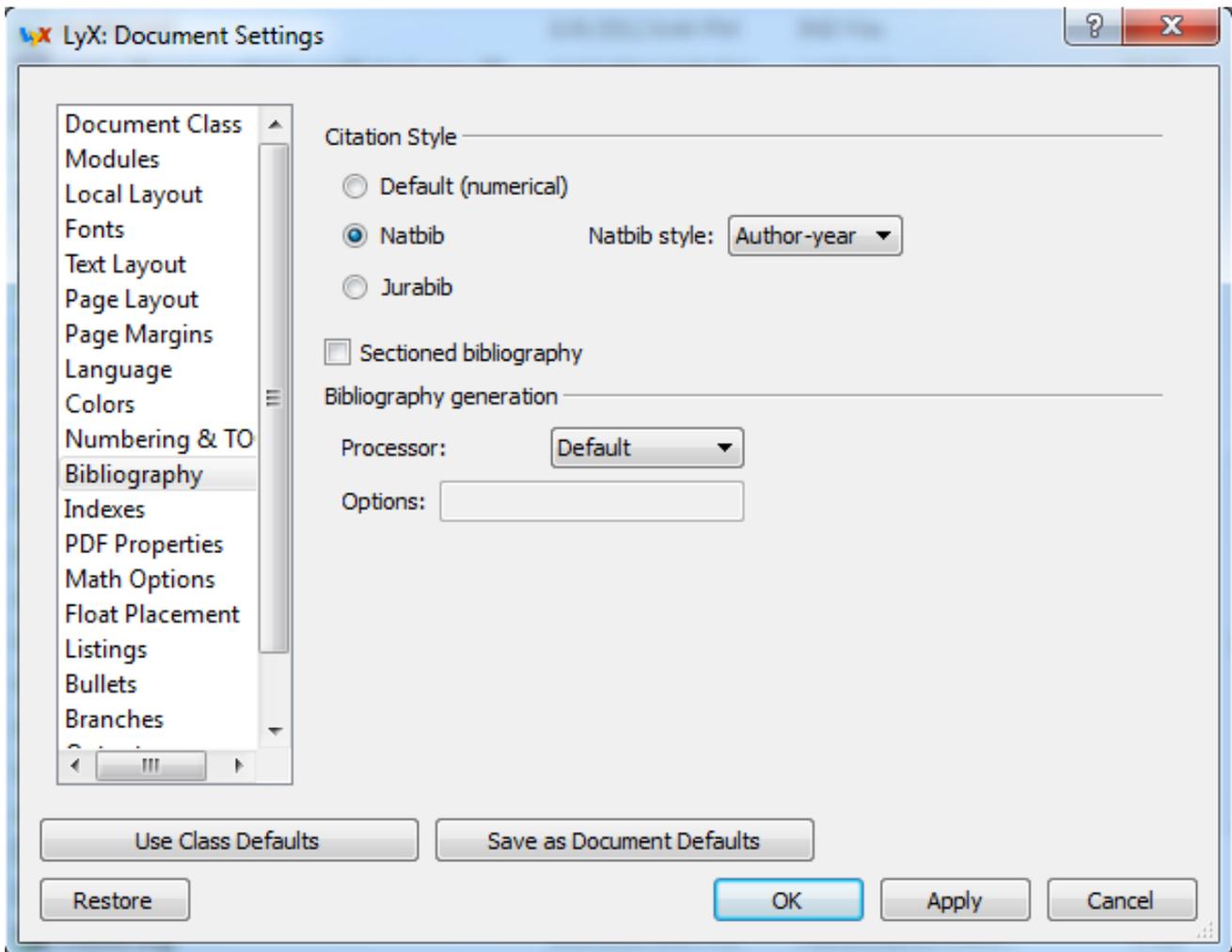
The Bibtexkey in the JabRef file is very important because this is how you will reference a paper from within LyX. If there is not a Bibtexkey entry for a paper already, one needs to be created by selecting the row for the paper in the JabRef table and the “Autogenerate BibTeX keys” icon  on the toolbar.

To insert a bibliography into the master LyX document, select **INSERT > LIST / TOC > BIBTEX BIBLIOGRAPHY** to bring up the window below:



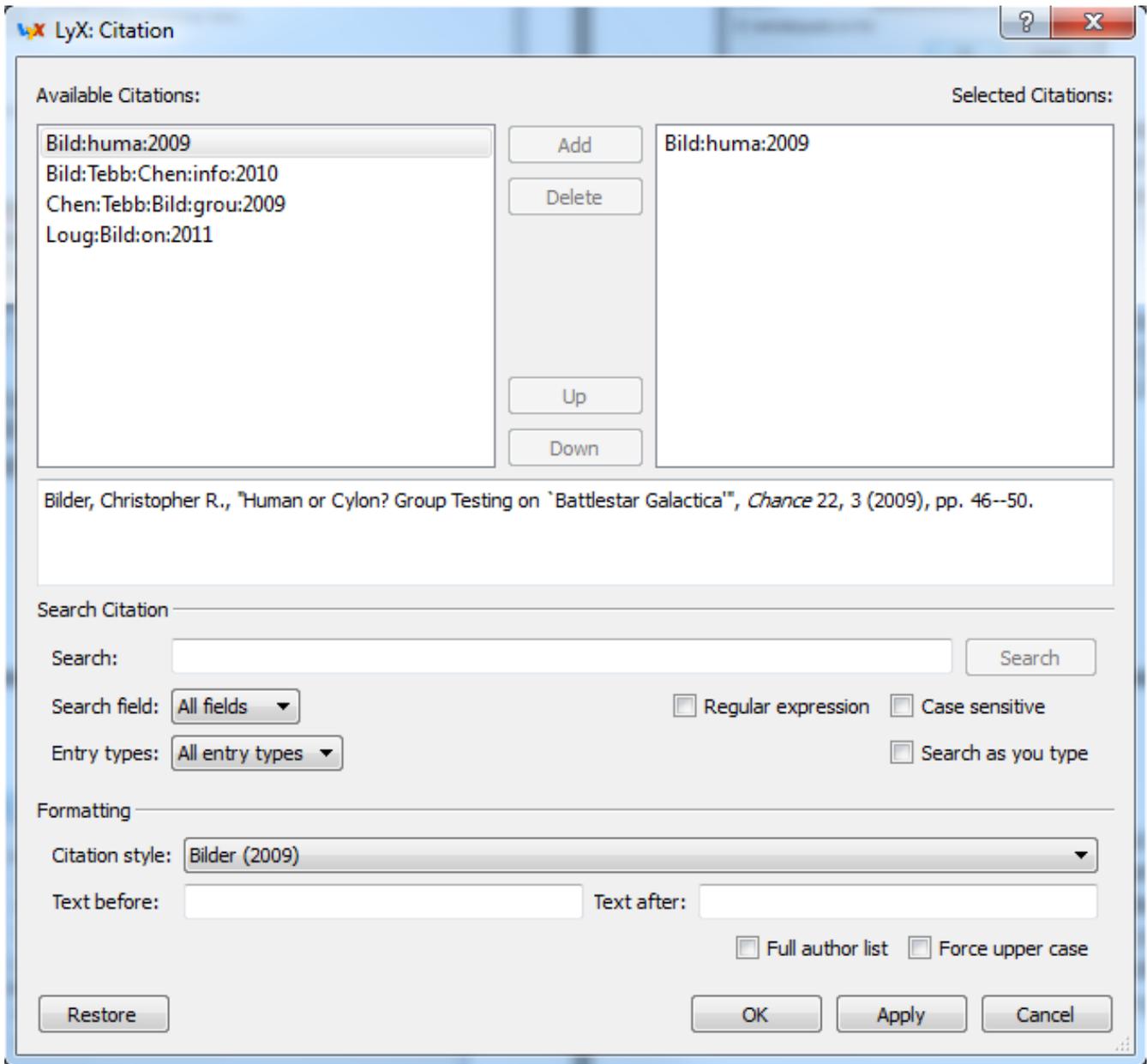
I have added my ref.bib file by browsing to its location. I am using the apa style for the bibliography style. Note that some journals will have their own .bst file that could be used here instead to control the bibliography style. I checked the “Add bibliography to TOC” box so that the bibliography is listed in the table of contents.

To control how citations look in the document (e.g., Bilder (2009) or [1] or Bilder [1]), select DOCUMENT > SETTINGS > BIBLIOGRAPHY IN LyX.



I chose the Natbib citation style which gives one similar to many statistical journals.

To insert a citation in the document, select INSERT > CITATION (📖 in the extra toolbar) at the desired location in the text. A window will appear that contains all of the references in the ref.bib file.



These reference names are given by the Bibtexkey in the .bib file. You can select a reference on the left side and then the add button to move its name to the right side. The desired formatting style can be chosen then toward the bottom of the window. By selecting OK, the citation will be put into the document. Below is what the document looks like with two references:

**Bilder (2009)** examines how group testing can be used to determine who is human and who is Cylon on the TV show Battlestar Galactica. If only the humans on the Galactica knew of my research, they could have reach Earth much faster.

**Bilder et al. (2010)** proposes “informative retesting” which is a method to decrease the number of tests needed to screen a population for a disease.

By clicking on a gray reference, the “LyX: Citation” window will appear again.

Below is what the bibliography looks like in the PDF:

## Bibliography

Bilder, C. R. (2009). Human or cylon? Group testing on ‘Battlestar Galactica’. *Chance*, 22(3):46–50.

Bilder, C. R., Tebbs, J. M., and Chen, P. (2010). Informative retesting. *Journal of the American Statistical Association*, 105(491):942–955.

This is a standard style found in many statistical research journals.

Note that you may need to compile the document more than once. The reason is because during the first pass through the document, L<sup>A</sup>T<sub>E</sub>X will create a list of references. In the second pass, it links the cross-references in the document with the bibliography.

15. Index: In order to include items in an index, put the cursor in the location of the document where you want a page number recorded for the index. Select INSERT > INDEX ENTRY ( in the extra toolbar) to create a field for the index (labeled “Idx”). Type the word that you would like given in the index for the entry.

Select INSERT > LIST/TOC > INDEX LIST in the master document to insert the index. In order to have the index appear in the table of contents, I had to use the following L<sup>A</sup>T<sub>E</sub>X code:

```
\addcontentsline{toc}{chapter}{Index}
```

```
Index
```

## Using .sty and .cls files

Journals will often provide .sty or .cls files for you to use with a L<sup>A</sup>T<sub>E</sub>X document. Using a .sty file is not too difficult in LyX. As with L<sup>A</sup>T<sub>E</sub>X, you can put the .sty file in the same folder as the .lyx file and use `\usepackage` in the preamble to reference it.

Working with .cls files requires a little more work. A LyX layout file (.layout) needs to be created that references the specific .cls file. These layout files are simple text files that point to the .cls file and provide additional directions as needed. My *Biometrics* paper example shows a simple layout file (biom.layout) of the following form:

```
% Do not delete the line below; configure depends
on this
# \DeclareLATEXClass[biom]{article (biom)}
# Input general definitions
Input stdclass.inc
```

I just simply found other layout files on my computer (C:\Program Files (x86)\LyX 2.2\Resources\layouts) and inserted “biom” for the biom.cls file. This layout file and the .cls file should be in the same folder as the .lyx file which uses it.

To let LyX know about the file, select DOCUMENT > SETTINGS > DOCUMENT CLASS and choose the layout file by selecting LOCAL LAYOUT. After selecting OK, I can now compile the document with biom.cls.

LyX’s web page at <http://wiki.lyx.org/Layouts/Layouts> provides additional information regarding layout files.

## UNL thesis

The Department of Mathematics at <http://www.math.unl.edu/graduate> (under “For Current Students” and “Resources”) has a .zip file which contains `nuthesis.layout` and `NUThesisTemplate.lyx`. The layout file needs to be used in the same way as the `biom.layout` file in the previous discussion. From the `nuthesis.zip` file discussed in my L<sup>A</sup>T<sub>E</sub>X notes, you need to get the `nuthesis.cls` file and use it in the same way as the `biom.cls` file in the previous discussion.

## Final comments

- A `.lyx~` file is always created with every save of the `.lyx` document. This is just a back-up file.
- Text in a PDF file will sometimes extend beyond the right margin. This is a problem with L<sup>A</sup>T<sub>E</sub>X, not LyX. A potential solution to the problem is to give a `\tolerance` command in the preamble. For example, my book uses `\tolerance=5000`. This 5000 value is used by L<sup>A</sup>T<sub>E</sub>X’s spacing algorithm to better arrange text.
- LyX allows for tracked changes in a similar manner as Word. Select **View > Toolbars > Review (Auto)** to open a toolbar that allows one to track, accept, or decline changes.