Quarto article template

A simple example

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1592-03-14

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`Keywords`

- Provides a list of keywords relevant to your work.
- Think of these as "search terms" that other researchers might google to find your paper.

1 Abstract

- Brief "teaser" to draw the reader in and summary of what was done

- An abstract is a 150- to 250-word paragraph that provides readers with a quick overview of your essay or report and its organization. It should express your thesis (or central idea) and your key points; it should also suggest any implications or applications of the research you discuss in the paper. The function of an abstract is to describe, not to evaluate or defend, the paper. The abstract should begin with a brief but precise statement of the problem or issue, followed by a description of the research method and design, the major findings, and the conclusions reached. [source Links to an external site.]

2 Introduction

- This section includes a summary of the topic, why it is important, why the reader should continue, what work has been done in the past by other research groups, what are the "different points of views"/interpretations in the literature, what are you exploring, what questions are you trying to address, what are your goals and hypothesis, etc

- For a data driven study, the Introduction is about the data science question and the topics you plan to explore. It helps the reader to understand what the data science question is, what the supporting topics and issues are, and what the overall research area is all about. An introduction allows the reader to "get to know" the data science question and related areas of interest. Ideally, an introduction should make the reader *care* about the topics and read more. The Introduction is NOT about the datasets, variables, methods or models. The Intro should not contain any information about the dataset or the data cleaning, prep, processing, etc. These things should go into the methods section. Introductions can and should include basis, background, history, the state-of-the-art, images, references, etc. An introduction will also help the reader to understand who the topics affect and why the topics matter.

- The following bullets show common components of an introduction section, they come from the following source Links to an external site..

  - Introduce your topic
    * The first job of the introduction is to tell the reader what your topic is and why it's interesting or important. This is generally accomplished with a strong opening hook.The hook is a striking opening sentence that clearly conveys the relevance of your topic. Think of an interesting fact or statistic, a strong statement, a question, or a brief anecdote that will get the reader wondering about your topic.
  - Describe the background
    * Part of the introduction is a concise literature review to demonstrate that the writer is familiar with the relevant research. You can provide an overview of the most relevant research that has already been conducted. This is a sort of

miniature literature review, a sketch of the current state of research into your topic, boiled down to a few paragraphs.

* This should be informed by genuine engagement with the literature. Your search can be less extensive than in a full literature review, but a clear sense of the relevant research is crucial to inform your own work.

– Establish your research problem

* In an empirical research paper, try to lead into the problem on the basis of your discussion of the literature. Think in terms of these questions:

· What research gap is your work intended to fill?
· What limitations in previous work does it address?
· What contribution to knowledge does it make?

– Specify your objective(s)

* The research question is the question you want to answer in an empirical research paper. Present your research question clearly and directly, with a minimum of discussion at this point. The rest of the paper will be taken up with discussing and investigating this question; here you just need to express it.

– Map out your paper

* The final part of the introduction is often dedicated to a brief overview of the rest of the paper.
* In a paper structured using the standard scientific "introduction, methods, results, discussion" format, this isn't always necessary. But if your paper is structured in a less predictable way, it's important to describe the shape of it for the reader. If included, the overview should be concise, direct, and written in the present tense.

Here is an example of an internal cross-reference (Section 4.1)

Here is an example of a citation (Sharma et al. 2018)

2.0.1 Rendering Quarto

If you are also having trouble consider trying the following; (see Figure 1)

0) Make sure the terminal is visible in VSC so you can see the rendering output to troubleshoot if needed.

1) Work in `.ipynb` NOT in the `.qmd` format

2) Put the relevant header command content at the top of the `.ipynb` as a "raw" code cell

3) Use "Run All" in VSC and make sure all plots show up inside the `.ipynb` before rendering

4) Render the file by clicking the three dots and clicking "Render HTML" (the last four options are quarto rendering methods) (see image below)

5) If something doesn't seem to work or is buggy, try quitting and restarting VSC.

6) **ALTERNATIVE OPTION:** You can also render the `.ipynb` using the command line with $->$ `quarto preview "example.ipynb"`

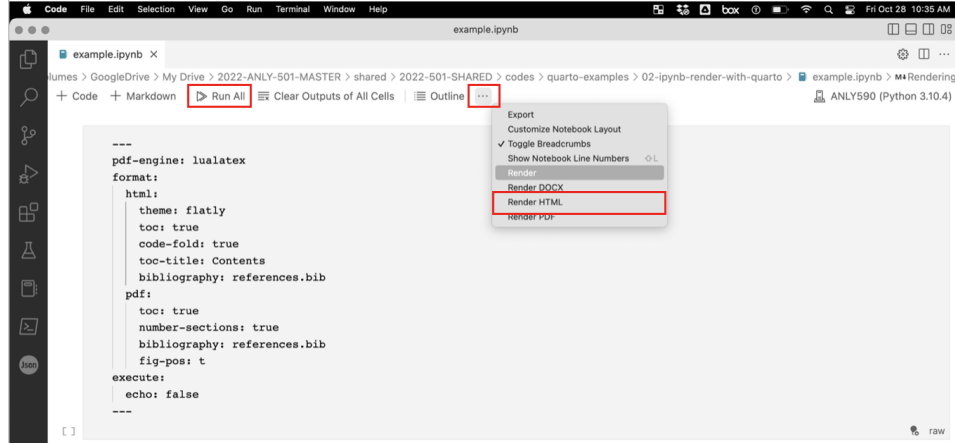NOTE: There is a working example of a `.ipynb` notebook rendered to html using quarto at the following link .

Figure 1: Render in VSC

3 Theory

3.1 Equations

This is an example of an inline math LaTex equation $f(x) = x^2$

This is an example of an display math LaTex equation

$$f(x) = x^2 + 1$$

Black-Scholes (Equation 1) is a mathematical model that seeks to explain the behavior of financial derivatives, most commonly options:

$$\frac{\partial C}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 C}{\partial C^2} + rS \frac{\partial C}{\partial S} = rC \tag{1}$$

Wave equation (Equation 2) is a mathematical model that seeks to explain the behavior of financial derivatives, most commonly options:

$$\frac{\partial^2 u}{\partial t^2} = c^2 \left(\frac{\partial^2 u}{\partial x_1^2} + \frac{\partial^2 u}{\partial x_2^2} + \cdots + \frac{\partial^2 u}{\partial x_n^2} \right) \tag{2}$$
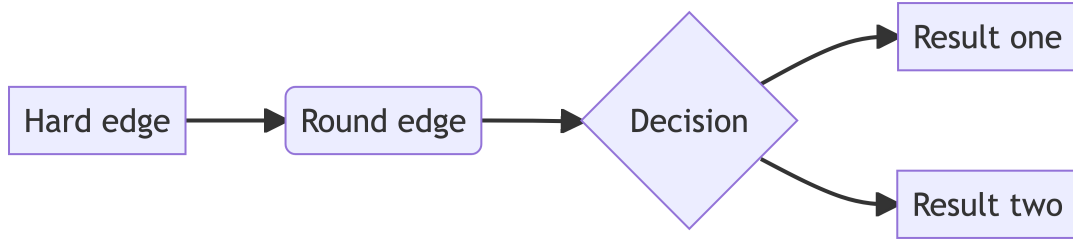
Multi-line equation (Equation 3)

$$\begin{aligned} A &= \frac{\pi r^2}{2} \\ &= \frac{1}{2}\pi r^2 \end{aligned} \tag{3}$$

3.2 Flow-charts

Quarto has native support for embedding Mermaid and Graphviz diagrams.

This enables you to create flowcharts, sequence diagrams, state diagrams, gnatt charts, and more using a plain text syntax inspired by markdown.

For example, here we embed a flowchart created using Mermaid:

4 Methods

- This section describes what you did, how you did it, and why you chose to do what you did.
- The methods section of a research paper provides the information by which a study's validity is judged. Therefore, it requires a clear and precise description of how a study was done, and the rationale for why specific procedures were chosen. The methods section should describe what was done to answer the research question, describe how it was done, justify the study design, and explain how the results were analyzed. Scientific writing is direct and orderly. Therefore, the methods section structure should: describe the materials used in the study, explain how the materials were prepared for the study, describe the research protocol, explain how measurements were made and what calculations were performed, and state which statistical tests were done to analyze the data. Once all elements of the methods section are written, subsequent drafts should focus on how to present those elements as clearly and logically as possibly. The description of preparations,

measurements, and the protocol should be organized chronologically. For clarity, when a large amount of detail must be presented, information should be presented in sub-sections according to topic. Material in each section should be organized by topic from most to least important source

4.1 Code

In this section we show how to demonstate, caption, and reference figures (both generated with code and externally loaded)

In (Figure 2) we show a plot showing decaying oscillations

Here is another example of a citation (Hickman and Mishin 2016)

In (Figure 3) we show a plot showing decaying oscillations

5 Results

- The results section should state the findings of the research without bias or interpretation.

- What is your interpretation of the results, why is it relevant, what does it mean, why were the discoveries important or useful, what effects do the results have on the world

6 Conclusions

- The goal is to summarize & wrap-up the report or paper. It explains what was found, in a way that would make sense to a general readership.

- This area is non-technical. Technical descriptions of what you did belong in the methods sections, while technical results belong in the results sections, not conclusions.

- The Conclusions should focus on key and important findings and how these findings affect real-life and real people.

- Some say that the Conclusions are the most difficult to write. If you do not understand what you really did, how can you explain it to others? Being able to make technical results and complex models use-able to normal humans (like managers, CEOs, Deans, clients, etc.) is critical in data science. The Conclusions area is important and if it is not good, many points can be lost.
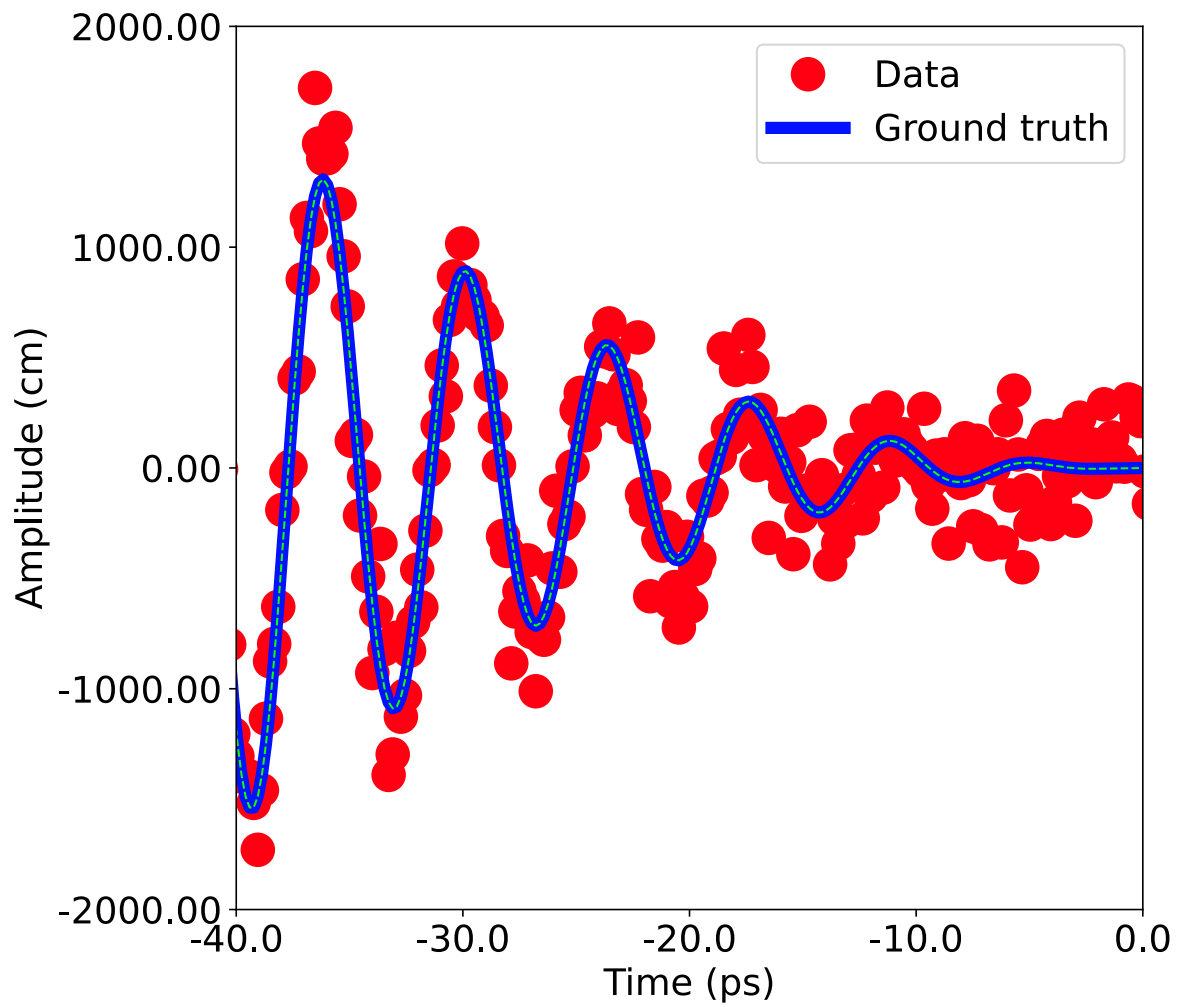
Figure 2: A plot showing decaying oscillations

Parameters and Function transformations

Transformation Rules for Functions		
Function Notation	**Type of Transformation**	**Change to Coordinate Point**
f(x) + d	Vertical translation up d units	(x, y) → (x, y + d)
f(x) – d	Vertical translation down d units	(x, y) → (x, y – d)
f(x + c)	Horizontal translation left c units	(x, y) → (x – c, y)
f(x – c)	Horizontal translation right c units	(x, y) → (x + c, y)
–f(x)	Reflection over x-axis	(x, y) → (x, –y)
f(–x)	Reflection over y-axis	(x, y) → (–x, y)
af(x)	Vertical stretch for $|a| > 1$	(x, y) → (x, ay)
	Vertical compression for $0 < |a| < 1$	
f(bx)	Horizontal compression for $|b| > 1$	$(x, y) \rightarrow \left(\dfrac{x}{b}, y \right)$
	Horizontal stretch for $0 < |b| < 1$	

https://www.onlinemathlearning.com/parent-functions.html

MODEL = Functional form + Parameterization
(underlying shape) (stretching and shifting)

$y = f(x) \rightarrow$ **"parent function"**

$$y = f(x \,|\, \mathbf{p}) = A f\left(\frac{x - x_o}{w} \right) + S$$

$$\mathbf{p} = (A, x_o, w, S)$$

A = **verticle stretch (amplitude)**
x_o = **horizontal shift (recentering parameter)**
w = **horizontal stretch (width parameter)**
S = **verticle shift (shift parameter)**

Example: $f(x) = e^{-x^2}$

$$y = f(x \,|\, \mathbf{p}) = A \cdot \exp^{-\left(\frac{x - x_o}{w} \right)^2} + S$$

$$x_i \rightarrow \tilde{x}_i = \frac{x_i - \mu_x}{\sigma_x}$$

Alternative form: $y = f(x \,|\, \mathbf{p}) = A f(w_1 x + b) + S$

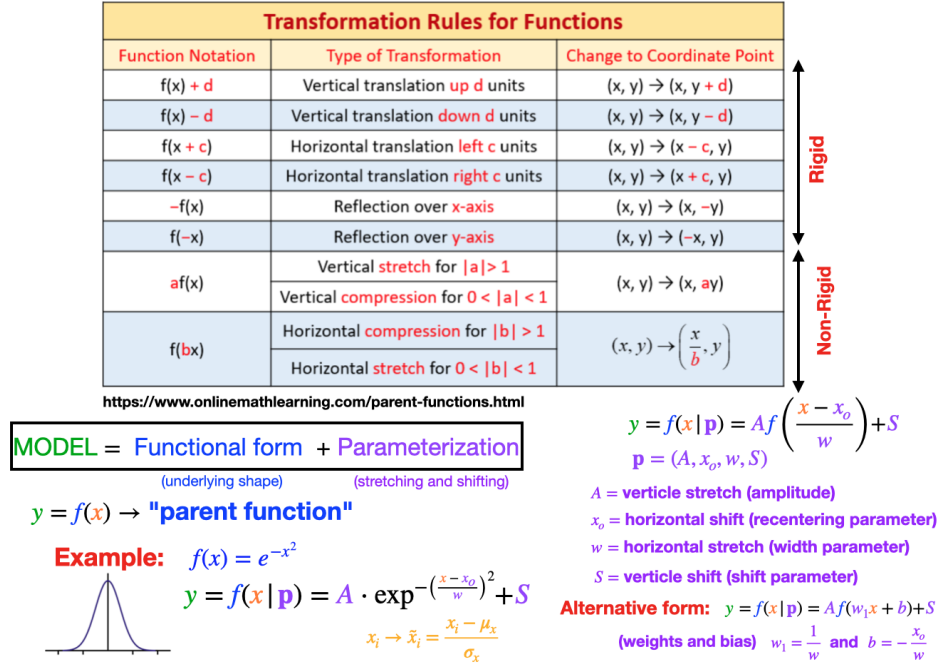**(weights and bias)** $w_1 = \frac{1}{w}$ and $b = -\frac{x_o}{w}$

Figure 3: An example of another figure example

- A conclusion is an important part of the paper; it provides closure for the reader while reminding the reader of the contents and importance of the paper. It accomplishes this by stepping back from the specifics in order to view the bigger picture of the document. In other words, it is reminding the reader of the main argument [source Links to an external site.]

- For most papers, it is usually a few paragraphs that simply and succinctly restates the main ideas and arguments, pulling everything together to help clarify the thesis of the paper. A conclusion does not introduce new ideas; instead, it should clarify the intent and importance of the paper. It can also suggest possible future research on the topic [source Links to an external site.]

6.1 References

Hickman, J, and Y Mishin. 2016. "Temperature Fluctuations in Canonical Systems: Insights from Molecular Dynamics Simulations." *Physical Review B* 94 (18): 184311.

Sharma, A, J Hickman, N Gazit, E Rabkin, and Y Mishin. 2018. "Nickel Nanoparticles Set a New Record of Strength." *Nature Communications* 9 (1): 1–9.