# Getting Started with Quarto

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In this document we will introduce a number of the key features Quarto markdown files support. We will be following the basic tutorial from Quarto as well as summarising some of the more advanced features introduced in their comprehensive guide. [1]

[1] Blog photo by Setyaki Irham from Unsplash

## 0.1 What is Quarto?

Quarto allows you to easily share and publish your code/analysis/research through any of markdown/`jupyter`/`knitr`. It is an extension of pandoc and offers support for `python`/`R`/`Julia`.

### 0.1.1 Best features

- render `jupyter` notebooks
- render markdown with code
- advanced visual customisation - figures, layout, citations
- create simple and easily customisable websites
- Great integration with VSCode and Github Pages.

## 0.2 Why use quarto?

Sharing jupyter notebooks is tedious. Either you share a link to a prerendered notebook on github or you awkwardly convert to html/pdf with a variety of tools.

*The problem?* The conversion of a notebook is awkward. Often you have to choose between removing all or including all the code. And while the markdown support within `jupyter` is good again the customisation is limited.

Quarto solves this. It is a rendering tool that gives you a number of options with customise how code, figures and text are arranged when converting to `html` and `pdf`.

Even better it provides a new markdown format `.qmd` that allows you to write `python` code within a markdown document (similar to `R markdown`) or link to figures within a precomputed `jupyter` notebook.

# 1 writing Code

## 1.1 NumPy

Create code blocks in markdown using ```` ```{python} ````

````
::: {.cell execution_count=1}
``` {.python .cell-code}
import numpy as np
a = np.arange(15).reshape(3, 5)
a
```

::: {.cell-output .cell-output-display execution_count=7}
```
array([[ 0,  1,  2,  3,  4],
       [ 5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14]])
```
:::
:::
````

```
import numpy as np
a = np.arange(15).reshape(3, 5)
a
```

```
array([[ 0,  1,  2,  3,  4],
       [ 5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14]])
```

## 1.2 Matplotlib

Control how figures appear with comments `#| keyword: value`. [2]

[2] The getting started tutorial has a nice description of the main options for figures and code output

````
```python
#| label: fig-limits-eg
#| fig-cap: "Errorbar limit selector"

import matplotlib.pyplot as plt

fig = plt.figure()
x = np.arange(10)
```
````

```
y = 2.5 * np.sin(x / 20 * np.pi)
yerr = np.linspace(0.05, 0.2, 10)

plt.errorbar(x, y + 3, yerr=yerr, label='both limits (default)')
plt.errorbar(x, y + 2, yerr=yerr, uplims=True, label='uplims=True')
plt.errorbar(x, y + 1, yerr=yerr, uplims=True, lolims=True,
             label='uplims=True, lolims=True')

upperlimits = [True, False] * 5
lowerlimits = [False, True] * 5
plt.errorbar(x, y, yerr=yerr, uplims=upperlimits, lolims=lowerlimits,
             label='subsets of uplims and lolims')

plt.legend(loc='lower right')
plt.show(fig)
```

```
import matplotlib.pyplot as plt

fig = plt.figure()
x = np.arange(10)
y = 2.5 * np.sin(x / 20 * np.pi)
yerr = np.linspace(0.05, 0.2, 10)

plt.errorbar(x, y + 3, yerr=yerr, label='both limits (default)')
plt.errorbar(x, y + 2, yerr=yerr, uplims=True, label='uplims=True')
plt.errorbar(x, y + 1, yerr=yerr, uplims=True, lolims=True,
             label='uplims=True, lolims=True')

upperlimits = [True, False] * 5
lowerlimits = [False, True] * 5
plt.errorbar(x, y, yerr=yerr, uplims=upperlimits, lolims=lowerlimits,
             label='subsets of uplims and lolims')

plt.legend(loc='lower right')
plt.show(fig)
```

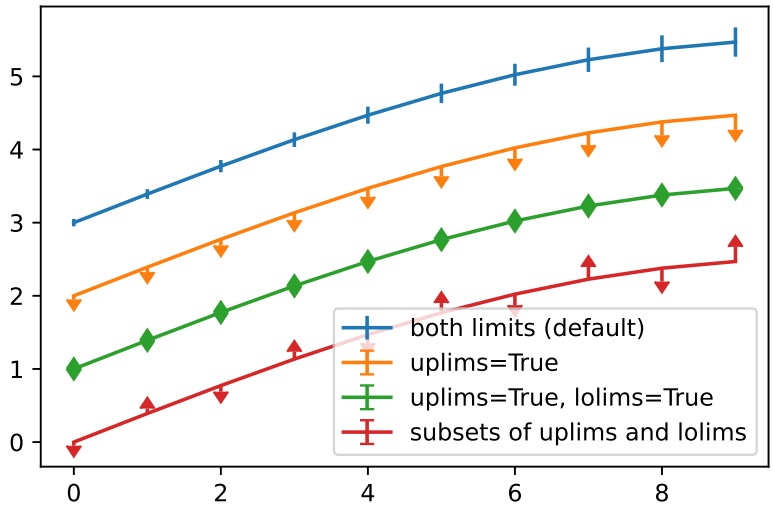



Figure 1: Errorbar limit selector

## 1.3 Plotly

### 1.3.1 without options

```
import plotly.express as px
import plotly.io as pio
gapminder = px.data.gapminder()
gapminder2007 = gapminder.query("year == 2007")
fig = px.scatter(gapminder2007,
                 x="gdpPercap", y="lifeExp", color="continent",
                 size="pop", size_max=60,
                 hover_name="country")
fig.show()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

### 1.3.2 With Options

```
import plotly.express as px
import plotly.io as pio
gapminder = px.data.gapminder()
gapminder2007 = gapminder.query("year == 2007")
fig = px.scatter(gapminder2007,
                 x="gdpPercap", y="lifeExp", color="continent",
                 size="pop", size_max=60,
                 hover_name="country")
fig.show()

gapminder1957 = gapminder.query("year == 1957")
fig = px.scatter(gapminder1957,
                 x="gdpPercap", y="lifeExp", color="continent",
                 size="pop", size_max=60,
                 hover_name="country")
fig.show()
```

```
Unable to display output for mime type(s): text/html
```

```
Unable to display output for mime type(s): text/html
```

(a) Gapminder: 1957

(b) Gapminder: 2007

Figure 2: Life Expectancy and GDP

## 1.4 From Notebooks

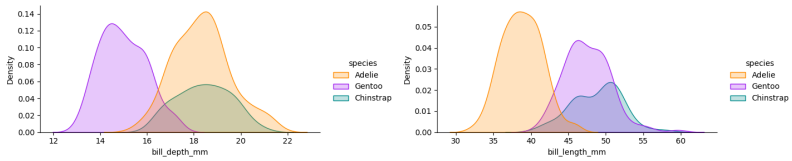
It is simple to embed plots from precomputed notebooks and include a link.

```
{{< embed penguins.ipynb#fig-bill-scatter >}}
```

```
alt.Chart(...)
```

Figure 3: A scatterplot of bill dimensions for penguins, made with Altair.

```
{{< embed penguins.ipynb#fig-bill-marginal >}}
```




(a) Gentoo penguins tend to have thinner bills, (b) and Adelie penguins tend to have shorter bills.

Figure 4: Marginal distributions of bill dimensions

You can also include the code by specifying `echo=true` in the call.

```
{{< embed penguins.ipynb#species-counts echo=true >}}
```

```
penguins.groupby("species").size().reset_index(name = "count")
```

| | species | count |
|---|---|---|
| 0 | Adelie | 152 |
| 1 | Chinstrap | 68 |
| 2 | Gentoo | 124 |

You can control how the link to the notebook appears in the title metadata [3]

[3] See the notebook embedding tutorial for more info

```
notebook-view:
  - notebook: penguins.ipynb
    title: "Plots and Computations"
```

### 1.5 rendering code

There are a number of ways to control the rendering of code. For example, if you have a notebook with some code that takes a long time to run you won't want to recompute it everytime you change formatting. There are many options to control this behaviour. [4]

[4] see the python tutorial for a more in depth explanation

```
execute:
  freeze: true
```

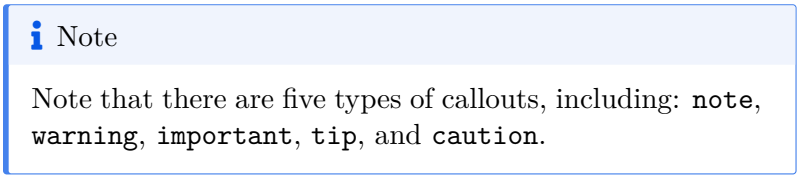
## 2 Formatting [7]

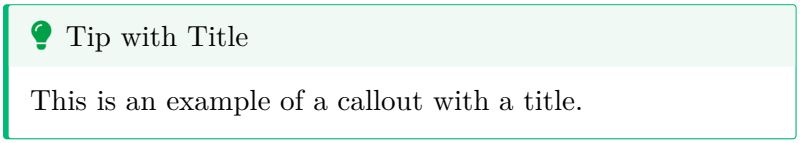
### 2.1 callout blocks

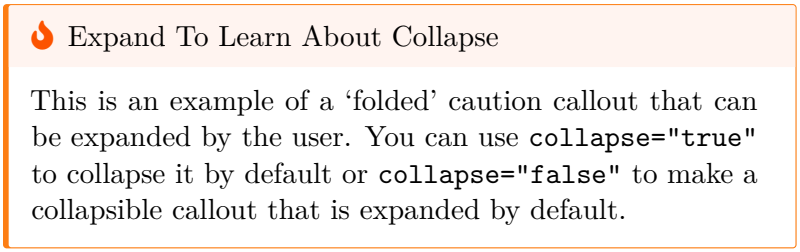
Quarto has nice control for adding note blocks. There are five formats [5] - note - warning - important - tip - caution

[5] See their tutorial for a more in depth explanation

```
::: {.callout-note}
Note that there are five types of callouts, including:
`note`, `warning`, `important`, `tip`, and `caution`.
:::

::: {.callout-tip}
## Tip with Title

This is an example of a callout with a title. See [their tutorial](https://quarto.org/docs/autl
:::

::: {.callout-caution collapse="true"}
## Expand To Learn About Collapse

This is an example of a 'folded' caution callout that can be expanded by the user. You can use
:::
```



## 2.2 Cross referencing

```
import matplotlib.pyplot as plt
plt.plot([1,23,2,4])
plt.show()
```

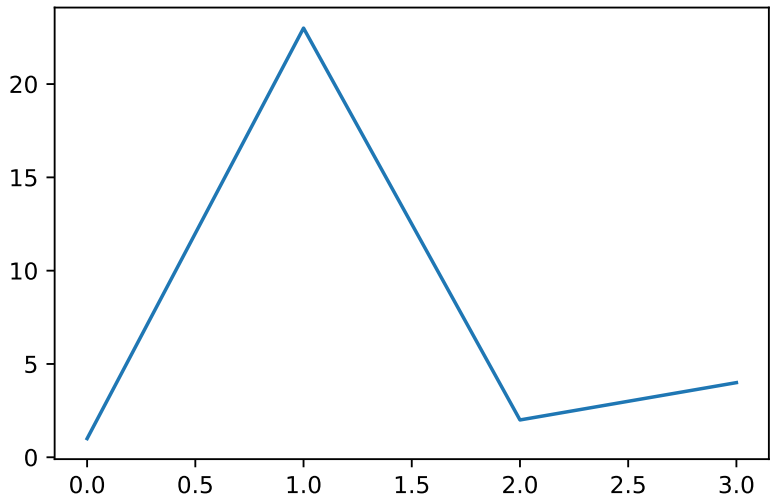



Figure 5: A line plot

This is a cross reference to our figure Figure 5 with `@fig-line-plot`. We can also reference the matplotlib figure above Figure 1 `@fig-limits`.

> **Note**
>
> You must start your label with `fig-` e.g. `fig-line-plot` for the cross reference to work.

## 2.3 Citations

You can include citations by including a bibliography.

For example, Antoine et al produced some sick work (Lain et al. 2022).

Add a path to your bibliography in the title metadata

```
---
title: "My Document"
bibliography: references.bib
---
```

You can customise citation style and more.[6]

[6] Footnotes are also possible. For more guidance see the quarto tutorial

```
---
title: "My Document"
bibliography: references.bib
csl: nature.csl
---
```

> **Note**
>
> You can download csl files from the CSL repo. nature.csl was taken from here (there are so many I had to search to get it.)

Citation can also be placed in the margin by adding

```
citation-location: margin
```

## 2.4 Equations

We can also write equations.

They can be placed inline $\frac{d}{dx}\left( \int_{a}^{x} f(u)\,du\right)=f(x).$
`$\frac{d}{dx}\left( \int_{a}^{x} f(u)\,du\right)=f(x).$`.

They can be placed centrally.

```
$$\frac{d}{dx}\left( \int_{a}^{x} f(u)\,du\right)=f(x).$$
```

$$\frac{d}{dx}\left( \int_{a}^{x} f(u)\,du\right)=f(x).$$

But they can also be placed in the margin

```
::: {.column-margin}
We know from *the first fundamental theorem of calculus* that for $x$ in $[a, b]$:


$$\frac{d}{dx}\left( \int_{a}^{x} f(u)\,du\right)=f(x).$$

:::
```

Lain, Antoine, Wonjin Yoon, Hyunjae Kim, Jaewoo Kang, and Ian Simpson. 2022. "KU_ED at SocialDisNER: Extracting Disease Mentions in Tweets Written in Spanish." In *Proceedings of the Seventh Workshop on Social Media Mining for Health Applications, Workshop & Shared Task*, 78–80. Gyeongju, Republic of Korea: Association for Computational Linguistics. https://aclanthology.org/2022.smm4h-1.23.

We know from *the first fundamental theorem of calculus* that for $x$ in $[a, b]$:

$$\frac{d}{dx}\left( \int_{a}^{x} f(u)\,du\right)=f(x).$$