The Seven Wonders of the World – a text on physics and natural philosophy

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Contents

Preface

This is a collection of notes on various topics in physics, especially: classical mechanics & thermodynamics (that is, thermomechanics), general relativity, quantum theory, statistical mechanics.

Parts of these notes could be material for a textbook, although the notes as a whole cannot be considered one. My idea is not to present a physics course from the ground up; this would lead to repeating material that can already be found in good textbooks. Rather, I would like to replace the presentation and development of some topics, common to many textbooks, with different ones that I have not found in any textbook.

The reason is that most undergraduate textbooks on physics – even those which appear in brand-new "latest editions" with flashy covers – contain very outdated and sometimes even incorrect ideas and notions.

It is due time to update them.

Some examples:

1. Classical Newtonian mechanics can today be presented through notions and maths that make it extremely close to general relativity. Such an alternative presentation makes many notions much clearer and easier to understand for students, and at the same time reduces to a smooth transition the conceptual jump that students usually have to make when studying special and general relativity.

2. What many undergraduate physics textbooks call "thermodynamics" is usually just thermo*statics*, and moreover a thermostatics presented through obscure and unwieldy maths. Results that are only valid in static situations, say, the famous formula "$p = nRT/V$", are presented as if they were also valid in non-static situations. Results that are only valid for elastic systems – that is, systems whose states can all be connected by reversible processes – are presented as if they were also valid for non-elastic systems. One important example is the statement that "entropy is defined up to an additive constant", which is far from being valid for all thermodynamic systems; in fact, it is false for many common everyday systems.

Chapter 1

Introduction

You can label chapter and section titles using `{#label}` after them, e.g., we can reference Chapter 1. If you do not manually label them, there will be automatic labels anyway, e.g., Chapter 3.

Figures and tables with captions will be placed in `figure` and `table` environments, respectively.

```
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

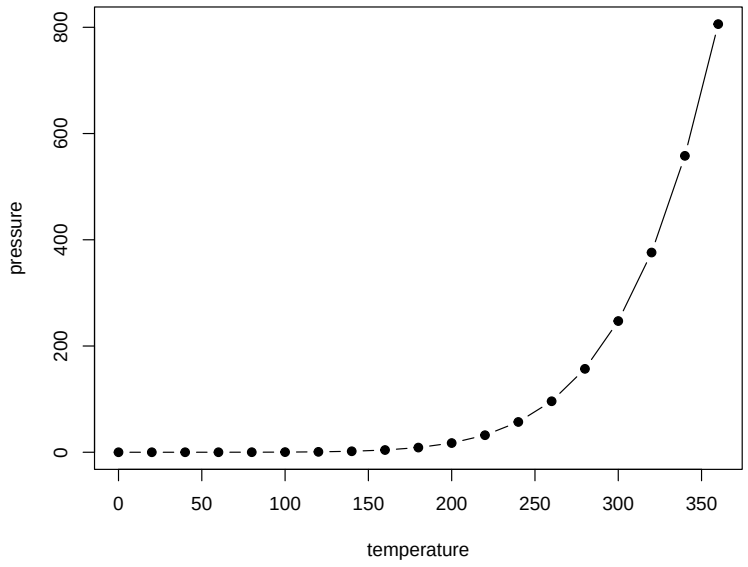

Figure 1.1: Here is a nice figure!

Table 1.1: Here is a nice table!

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa
5.0	3.6	1.4	0.2	setosa
5.4	3.9	1.7	0.4	setosa
4.6	3.4	1.4	0.3	setosa
5.0	3.4	1.5	0.2	setosa
4.4	2.9	1.4	0.2	setosa
4.9	3.1	1.5	0.1	setosa
5.4	3.7	1.5	0.2	setosa
4.8	3.4	1.6	0.2	setosa
4.8	3.0	1.4	0.1	setosa
4.3	3.0	1.1	0.1	setosa
5.8	4.0	1.2	0.2	setosa
5.7	4.4	1.5	0.4	setosa
5.4	3.9	1.3	0.4	setosa
5.1	3.5	1.4	0.3	setosa
5.7	3.8	1.7	0.3	setosa
5.1	3.8	1.5	0.3	setosa

Reference a figure by its code chunk label with the `fig:` prefix, e.g., see Figure 1.1. Similarly, you can reference tables generated from `knitr::kable()`, e.g., see Table 1.1.

```
knitr::kable(
  head(iris, 20), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

You can write citations, too. For example, we are using the **bookdown** package (Xie, 2023) in this sample book, which was built on top of R Markdown and **knitr** (Xie, 2015).

Chapter 2

Literature

Here is a review of existing methods.

Chapter 3

Methods

We describe our methods in this chapter.

Math can be added in body using usual syntax like this

3.1 math example

p is unknown but expected to be around 1/3. Standard error will be approximated

$$SE = \sqrt{(\frac{p(1-p)}{n})} \approx \sqrt{\frac{1/3(1-1/3)}{300}} = 0.027$$

You can also use math in footnotes like this[1].

We will approximate standard error to 0.027[2]

[1] where we mention $p = \frac{a}{b}$

[2] p is unknown but expected to be around 1/3. Standard error will be approximated

$$SE = \sqrt{(\frac{p(1-p)}{n})} \approx \sqrt{\frac{1/3(1-1/3)}{300}} = 0.027$$

Chapter 4

Applications

Some *significant* applications are demonstrated in this chapter.

4.1 Example one

4.2 Example two

Chapter 5

Final Words

We have finished a nice book.

Bibliography

Xie, Y. (2015). *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition. ISBN 978-1498716963.

Xie, Y. (2023). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.33.