

# Historia I

## Apuntes e materiais didáticos



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Conservatorios Profesionais de Música

Apuntes e materiais didáticos

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A todas aquelas persoas que colaboraron neste traballo

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Roberto Prado  
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# Abstract

En construcción ...

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# Glosario

- 1-D, 2-D** . . . . One- or two-dimensional, referring **in this thesis** to spatial dimensions in an image.
- Otter** . . . . . One of the finest of water mammals.
- Hedgehog** . . . Quite a nice prickly friend.

# Introdución

## Definicións e conceptos

O estudo da historia da música que interpretamos e transmitimos, así como da que escoitamos supón un aspecto de gran importancia dentro da formación de todo músico.

A finalidade da Historia da Música é escoitar música, captar as características das distintas correntes estéticas de cada época, comprender a música e relacionala coas correntes estéticas, comprender e coñecer os feitos históricos e movementos socioculturais máis destacados así como o contexto no que se orixinaron, permite valorar a importancia que a música ten na sociedade e igualmente a relación entre a música e o resto de artes.

Comezamos este curso facendo un percorrido histórico, artístico e musical polas épocas anteriores á actual, coa finalidade de coñecer e comprender mellor a música e os elementos que forman parte dunha obra de arte musical. Faremos un percorrido pola música de diferentes épocas e civilizacións, centrándonos na música occidental e a súa evolución ata os nosos días, tendo en conta a importancia da cultura musical na Península Ibérica e Galicia.

Nos primeiros capítulos, trataremos a orixe da música e a música na prehistoria, prestando especial atención ás primeiras evidencias conservadas de música escrita que foron descifradas e comprendidas (desde a idade da memoria); veremos as teorías sobre a música da Antigüidade e finalmente trataremos en profundidade a evolución da música escrita desde a Idade Media (idade da notación) ata o Renacemento.

## Concepto de música

Se tratamos de definir a música, poderíamos dicir que é un medio de expresión dos sentimentos humanos; unha manifestación artística e cultural dos pobos que adquire diferentes formas, valores estéticos e funcións segundo o seu contexto. En certo modo, resúltanos familiar este concepto dado que vivimos rodeados de música.

Se procuramos un significado tradicional ao concepto de «música»<sup>1</sup>, atopamos: >La música [...] es el [arte](#) de organizar sensible y lógicamente una combinación coherente de [sonidos](#) y [silencios](#) respetando los principios fundamentales de la [melodía](#), la [armonía](#) y el [ritmo](#), [...].<sup>2</sup>

A Real Adademia Galega da lingua, define a «música» como: > Arte de combinar harmoniosamente os sons, segundo unhas regras preestablecidas.

---

<sup>1</sup>Os gregos definen a música como «a arte das musas»

<sup>2</sup>Definición de [música](#) consultada na wikipedia.

Podemos concluír que, a música é unha combinación ordenada de ritmo, melodía e harmonía, agradable ao oído humano.

## Concepto de Historia da Música

Se ben unha o significado de «música» pode estar máis ou menos claro, abordaremos agora o significado de «historia da música».

*La **Historia de la música** es el estudio de las diferentes tradiciones en la música y su orden en el planeta.*

*[...] aquella disciplina que trata el estudio de la evolución de las diferentes tradiciones musicales a lo largo del tiempo.*

Estas son algúns significados que nos aproximan ao concepto que estamos a buscar. De xeito formal, atopamos os significados seguintes:

- a [Real Academia Española da lingua](#) (RAE) define textualmente «**historia**» como:

- 1.- *Narración y exposición de los acontecimientos pasados y dignos de memoria, sean públicos o privados.*
- 2.- *Disciplina que estudia y narra cronológicamente los acontecimientos pasados*
- 3.- *Conjunto de los sucesos o hechos políticos, sociales, económicos, culturales, etc., de un pueblo o de una nación.*
- 5.- *Conjunto de los acontecimientos ocurridos a alguien a lo largo de su vida o en un período de ella* <sup>3</sup>

■ a [Real Adademia Galega da lingua](#) (RAG), define «**historia**»:

1. Conxunto de feitos ocorridos no pasado, que afectan a toda a humanidade, a un grupo, unha persoa, unha institución, a unha faceta concreta dese pasado etc.
2. Ciencia que estuda eses feitos. <sup>4</sup>

Podemos afirmar entón que a finalidade da Historia da Música é, entre outras:

- o estudo da evolución das diferentes manifestacións musicais (a tradición musical) das culturas de occidente (neste caso as culturas e sociedades musicais europeas) ao longo do tempo.

<sup>3</sup>Definición de historia, RAE consultado en <https://www.rae.es>, (Setembro, 2020).

<sup>4</sup>Definición de historia, RAG consultado en <https://academia.gal/diccionario>, (Setembro 2020)

## Obxectivos e problemática da materia

O principal obxectivo da Historia da Música é o **estudo da evolución da música ao longo da historia da humanidade**. Agora ben, que imos estudar e como o faremos?

- centrámonos nas obras musicais ou en como se usaron?
- baseamos o estudo nas persoas que as desenvolveron(crearon) ou no ambiente social da época?
- Que criterios empregamos para seleccionar a música que estudaremos?

O principal problema é atopar unha definición máis ou menos aceptada e consensuada do que se entende por «música» dado que non significa e non se refire ao mesmo en tódalas culturas. Algunhas, inclúen dentro do concepto de «música» aspectos da danza, poesía, etc. e outras culturas, pola contra, non empregan ningún termo para referírense á música en sí.

Son frecuentes as discusións entre musicólogos, historiadores e grades entendidos sobre a música para lograr unha definición universal da música, pero é complicado universalizar este concepto dada a diversidade de culturas e pobos. O profesor Francisco Callejo, expón esta problemática:

[...] el primer problema que nos encontramos es acordar una definición universal de *música*: el concepto de música varía de una cultura a otra; por ejemplo, la mayor parte de los musulmanes no considerarían música la llamada a la oración del almuédano, que a los oídos occidentales suena similar a muchas salmodias medievales; los toques de campanas de las iglesias cristianas, por el contrario, no son considerados como manifestaciones musicales en occidente, aunque a muchos africanos les recordarían melodías suyas.<sup>5</sup>

Como vemos no exemplo anterior, o que se considera música para unha cultura, pode non selo para outra e viceversa. Pensemos nestas dúas preguntas, relacionadas co exemplo de Callejo:

- consideramos como música todo aquilo que alguén considera como tal? (caso do *almuédano*<sup>6</sup> e as campás)
- consideramos como música, pola contra, só o que todos consideramos música?

<sup>5</sup>Callejo, F.: *Historia de la Música*, Conservatorio Profesional de Música Francisco Guerreo (2017).

<sup>6</sup>[...] o muecín ou almuédano (“gritador”) era o musulmán que realizaba tradicionalmente a chamada á oración (*salat*) mediante a voz. Na actualidade, o almuédano foi substituído con frecuencia por un megáfono.

(Fonte: [wikiland](#))

### *0.1. A música como actividade vs a música como produto*

Por outra parte, a «historia da música occidental» exclúe moitas manifestacións musicais como a música popular actual, a música tradicional europea e non europea. Exclúe tamén do seu ámbito de estudo, a música clásica oriental chinesa, xaponesa ou india. Así o seu campo de estudo redúcese, exclusivamente á música culta europea, a pesares de si estudar algunha música non europea pero que segue certos cánones europeos.

Outra cuestión que influirá no concepto é a «orixe da cultura occidental»: cando comeza a cultura occidental? ou mellor dito, desde cando consideramos que comeza a cultura occidental?

## **0.1. A música como actividade vs a música como produto**

En primeiro lugar, diferenciaremos a música como **actividade**: unha ou máis persoas participan creando, interpretando ou escoitando música, en comparación coa música como **produto**: o resultado desta actividade é algo sólido, coa posibilidade de ser escrito con sistemas de notación dando como resultado, por exemplo unha obra musical. Neste caso, obtemos un produto (obra musical) resultante dunha actividade (composición). O enfoque máis común adoita ser o segundo, estudando exclusivamente obras musicais e non a actividade xerada ao seu redor.

## **0.2. Transmisión oral e transmisión escrita**

A posibilidade de estudar música historicamente, baséase na existencia dunha transmisión dela ao longo do tempo. En case todas as culturas e tempos, a música transmitiuse por medio da escoita e posterior repetición, isto é: escoitando e observando por exemplo aos profesores e profesoras. Isto é o que se chama **transmisión oral** (propio da idade da memoria)

Tamén existe a posibilidade de transmitir - e almacenar - música con varios métodos de escritura musical, dando lugar a transmisión escrita (idade de notación).

## **0.3. Música culta e música popular**

A actividade musical prodúcese en todos os grupos sociais e nun gran número de situacións diferentes. Algunhas manifestacións musicais adquiriron un maior prestixio social, ben pola súa relación con altos estratos da sociedade, ben polas súas características de formación e profesionalización. Estamos a diferenciar música académica, tamén coñecida como “clásica” ou “cult”, fronte a unha enorme variedade de música popular, normalmente con menos prestixio. O estudo da música debería abarcar todos os estilos pero, normalmente atende só ao estudo dos estilos académicos.

## 0.4. Música europea e non europea

O obxectivo principal da historia da música foi sempre o estudo da música europea, especialmente a dos últimos séculos; en parte, porque foi no continente europeo onde se crearon os principais tratados e estudos sobre música. Este enfoque “eurocéntrico” deixa fóra numerosas manifestacións musicais, tanto académicas como populares de fóra de Europa, que nalgúns casos tiveron unha forte influencia no propio desenvolvemento da música europea. Hoxe en día é común centrarse só na música europea e a súa influencia en músicos doutros continentes.

Cando estudamos a historia da música, adoitamos centrarnos en produtos musicais escritos da tradición académica europea, polo que acurtamos drasticamente o obxecto de estudo. O resto - actividade musical, transmisión oral, música popular ou non europea - son obxecto de estudo da etnomusicoloxía, que normalmente non aplica o enfoque histórico.

## 0.5. A actividade musical e os seus produtos

A actividade musical pode considerarse como un proceso bastante complexo, que abarca varias fases. Así falaremos de: **produción, difusión e consumo**.

ACTIVIDADE	TERMINO MUSICAL
Produción	Composición
Difusión	Interpretación
Consumo	Audición

Para estudar a actividade musical historicamente (o “proceso musical”), imos centrarnos igualmente nas tres fases do proceso. Non obstante, en moitos casos, as diferentes historias musicais céntranse só na primeira (produción) sen referirse aos intérpretes, ás técnicas de interpretación, aos contextos de escoita (audición), etc.

Ao longo do século XIX desenvóléronse dúas ideas ou conceptos importantes: o *canon* e o *repertorio*. O primeiro refírese ao conxunto de compositores e obras obxecto de estudo; o segundo é o conxunto de obras que, por unha ou outra razón, seguimos interpretando e escoitando. Ámbolos dous conceptos derivan de certos criterios de “calidade musical” malia que é certo que son, á súa vez, produtos culturais europeos creados en contextos políticos, sociais e ideolóxicos específicos.

O feito de que se exclúa a música non europea ou popular, fainos pensar na discriminación étnica e de clase, que mantiveron certos musicólogos, intérpretes, críticos, etc. do século XIX. A exclusión do canon da muller como compositora, é outro exemplo destes prexuízos e discriminación [^cita:exclusión\_muller], así como o silencio ao que foron sometidos aqueles compositores [^cita:exclusión\_compo] que non se axustaban ao modelo ou idea de evolución da música occidental da época. Sen dúbida, outra das



**Figura 1:** Logo de rmarkdown (desde arquivo PNG).

ideas que marcaron este concepto de canon foi a valoración dos nacionalismos,<sup>7</sup> que explica así que predominase certa música sobre outra.

A modo de conclusión, o concepto de *historia da música* redúcese ao estudo dunha serie de compositores e obras musicais da música culta (académica) occidental, que foron seleccionados seguindo certos criterios impostos en certas ocasións polas “modas musicais” da época.

```
knitr::include_graphics('figures/ud-00/rmarkdown.png')
```

## Conceptos previos

Chegados a este punto faremos unha introdución dos coñecementos que debemos ter en conta

## A música como feito social e cultural

Aquí falaremos da función social da música e a súa importancia como modo de introducir á historia da música do presente curso.

## As fontes de información histórica

A actividade musical é tan antiga como a especie humana. Salvo a época prehistórica, da que só se teñen vagas nocións por restos de posibles instrumentos atopados en xacementos e por pinturas rupestres, o coñecemento da música das culturas antigas ven dado polo que denominamos «fontes de información».

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<sup>7</sup>A idea do nacional ou nacionalista tamén influíu na creación do canon. O feito de que as universidades máis importantes de finais do século XIX e principios do XX fosen as de Alemaña e que a escola historiográfica alemá dominase un período decisivo na historiografía musical, explica a abundancia de compositores xermanos no canon.



## Fontes para o estudo da Música na Prehistoria e Antigüidade

En **historiografía**, denomínanse «fontes» a todo o que aporta información para o estudo dunha determinada cultura.

No caso da Historia da Música das Civilizacións da Prehistoria e a Antigüidade, as fontes son moi variadas. Así, falaremos de fontes de tipo iconográfico, como pinturas e esculturas; documentos escritos, como xeroglíficos e inscricións en tumbas ou templos; literarios como a Biblia, (entre outros); restos arqueolóxicos, como é o caso de fragmentos de instrumentos desa época atopados en sarcófagos.

Dentro do noso ámbito de estudo, consideramos como principais fontes de información as seguintes:

1. **Arqueoloxía.** Os restos arqueolóxicos proporcionan importante información sobre a música de épocas antigas. Os máis importantes son os instrumentos musicais —ou partes deles— que non se destruíron co paso do tempo; pero tamén se atopan restos de edificios e lugares onde se interpretaba música e danza. Entre os restos arqueolóxicos atópanse tamén as mostras máis antigas de notación musical.
2. **Iconografía.** A pintura, a escultura e outras obras das artes visuais proporcionan información sobre instrumentos musicais, contextos e prácticas de interpretación, danzas, etc.
3. **Literatura.** A literatura, entendida como o conxunto de todo o escrito, ofrece abundante información musical: algunhas fontes literarias describen escenas ou pensamentos musicais e tamén ideas sobre música; os textos da música vocal indican a estrutura rítmica, malia que non se conserven as melodías. Dentro da literatura hai que incluír tamén as obras técnicas sobre música como tratados, métodos, etc.
4. **Etnomusicoloxía.** A etnomusicología, o estudo das músicas de tradición oral actuais, pode axudar á comprensión da actividade musical antiga. Aínda que non é correcto supoñer que en condicións de vida iguais desenvólvense culturas musicais iguais, ás veces o coñecemento das músicas tradicionais actuais pode proporcionar detalles sobre técnicas de interpretación de instrumentos antigos ou sobre movementos de danza, por exemplo.

mermaid

graph TB;

Aa(Fontes de Información);

B(Arqueoloxía);

C(Iconografía);

D(Literatura);

E(Etnomusicoloxía);

A-->B

A-->C

A-->D

A-->E

### *0.5. A actividade musical e os seus produtos*

Case todos os libros sobre Historia da Música, comezan narrando as circunstancias da Música na Idade Media. Este feito, transmite a idea de que a orixe da música na cultura occidental está relacionado co canto gregoriano. Ata hai ben pouco, eran contados os manuais que trataban a importancia da cultura musical da Antigüidade Grega. Que pasa entón coa música anterior? Que sabemos sobre as danzas e os “concertos cortesáns” da época dos faraóns? Que instrumentos empregaban nas celebracións funerarias e nas ofrendas aos deuses?

*O obxectivo de toda obra artística é axudar a cantos viven  
neste mundo a abandonar as súas miserias e conducilos á  
verdadeira felicidade...*

— Dante Alighieri. *Carta al Gran Can de la Scala de  
Verona*, no preámbulo ao Paraíso.

# 1

## Orixes da Historia da Música Occidental

### Índice

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## Introdución

### As fontes de información histórica

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### Fontes para o estudo da Música na Prehistoria e Antigüidade

En **historiografía**, denomínanse «fontes» a todo o que aporta información para o estudo dunha determinada cultura.

No caso da Historia da Música das Civilizacións da Prehistoria e a Antigüidade, as fontes son moi variadas. Así, falaremos de fontes de tipo iconográfico, como pinturas e esculturas; documentos escritos, como xeroglíficos e inscricións en tumbas ou templos; literarios como a Biblia, (entre outros); restos arqueolóxicos, como é o caso de fragmentos de instrumentos desa época atopados en sarcófagos.

Dentro do noso ámbito de estudo, consideramos como principais fontes de información as seguintes:

1. **Arqueoloxía.** Os restos arqueolóxicos proporcionan importante información sobre a música de épocas antigas. Os máis importantes son os instrumentos musicais —ou partes deles— que non se destruíron co paso do tempo; pero tamén se atopan restos de edificios e lugares onde se interpretaba música e danza. Entre os restos arqueolóxicos atópanse tamén as mostras máis antigas de notación musical.
2. **Iconografía.** A pintura, a escultura e outras obras das artes visuais proporcionan información sobre instrumentos musicais, contextos e prácticas de interpretación, danzas, etc.
3. **Literatura.** A literatura, entendida como o conxunto de todo o escrito, ofrece abundante información musical: algunhas fontes literarias describen escenas ou pensamentos musicais e tamén ideas sobre música; os textos da música vocal indican a estrutura rítmica, malia que non se conserven as melodías. Dentro da literatura hai que incluír tamén as obras técnicas sobre música como tratados, métodos, etc.
4. **Etnomusicoloxía.** A etnomusicología, o estudo das músicas de tradición oral actuais, pode axudar á comprensión da actividade musical antiga. Aínda que non é correcto supoñer que en condicións de vida iguais desenvólvense culturas musicais iguais, ás veces o coñecemento das músicas tradicionais actuais pode proporcionar detalles sobre técnicas de interpretación de instrumentos antigos ou sobre movementos de danza, por exemplo.

## 1. Orixes da Historia da Música Occidental

```
mermaid
graph TB;
    Aa(Fontes de Información);
    B(Arqueoloxía);
    C(Iconografía);
    D(Literatura);
    E(Etnomusicoloxía);

    A-->B
    A-->C
    A-->D
    A-->E
```

Case todos os libros sobre Historia da Música, comezan narrando as circunstancias da Música na Idade Media. Este feito, transmite a idea de que a orixe da música na cultura occidental está relacionado co canto gregoriano. Ata hai ben pouco, eran contados os manuais que trataban a importancia da cultura musical da Antigüidade Grega. Que pasa entón coa música anterior? Que sabemos sobre as danzas e os “concertos cortesáns” da época dos faraóns? Que instrumentos empregaban nas celebracións funerarias e nas ofrendas aos deuses?

### 1.1. A orixe da música

#### As fontes de información histórica

A actividade musical é tan antiga como a especie humana. Salvo a época prehistórica, da que só se teñen vagas nocións por restos de posibles instrumentos atopados en xacementos e por pinturas rupestres, o coñecemento da música das culturas antigas ven dado polo que denominamos «fontes de información».

#### Fontes para o estudo da Música na Prehistoria e Antigüidade

En **historiografía**, denomínanse «fontes» a todo o que aporta información para o estudo dunha determinada cultura.

No caso da Historia da Música das Civilizacións da Prehistoria e a Antigüidade, as fontes son moi variadas. Así, falaremos de fontes de tipo iconográfico, como pinturas e esculturas; documentos escritos, como xeroglíficos e inscricións en tumbas ou templos; literarios como a Biblia, (entre outros); restos arqueolóxicos, como é o caso de fragmentos de instrumentos desa época atopados en sarcófagos.

Dentro do noso ámbito de estudo, consideramos como principais fontes de información as seguintes:

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4. **Etnomusicoloxía.** A etnomusicología, o estudo das músicas de tradición oral actuais, pode axudar á comprensión da actividade musical antiga. Aínda que non é correcto supoñer que en condicións de vida iguais desenvólvense culturas musicais iguais, ás veces o coñecemento das músicas tradicionais actuais pode proporcionar detalles sobre técnicas de interpretación de instrumentos antigos ou sobre movementos de danza, por exemplo.

mermaid

graph TB;

Aa(Fontes de Información);

B(Arqueoloxía);

C(Iconografía);

D(Literatura);

E(Etnomusicoloxía);

A-->B

A-->C

A-->D

A-->E

Case todos os libros sobre Historia da Música, comezan narrando as circunstancias da Música na Idade Media. Este feito, transmite a idea de que a orixe da música na cultura occidental está relacionado co canto gregoriano. Ata hai ben pouco, eran contados os manuais que trataban a importancia da cultura musical da Antigüidade Grega. Que pasa entón coa música anterior? Que sabemos sobre as danzas e os “concertos cortesáns” da época dos faraóns? Que instrumentos empregaban nas celebracións funerarias e nas ofrendas aos deuses?

## **1.2. A música durante a Prehistoria**

## **1.3. A música na prehistoria**

Este tema está redactado en modo texto sinxelo txt pero empregando sintaxe markdown para integralo no RStudio.

## **1.4. A música nas primeiras civilizacións**

### **1.4.1. Exipto**

### **1.4.2. Mesopotamia**

### **1.4.3. O antigo Oriente**

### **1.4.4. O pobo Hebreo**

## **1.5. A música no mundo clásico**

### **1.5.1. Grecia**

### **1.5.2. Roma**

## **1.6. Actividades**

## **1.7. Resumo**

# 2

## R Markdown basics

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---

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---

Here is a brief introduction to using *R Markdown*. *Markdown* is a simple formatting syntax for authoring HTML, PDF, and MS Word documents and much, much more. *R Mark-*



## 2. R Markdown basics

*down* provides the flexibility of *Markdown* with the implementation of **R** input and output. For more details on using *R Markdown* see <http://rmarkdown.rstudio.com>.

## 2.1. Basic markdown syntax

### 2.1.1. Whitespace

Be careful with your spacing. While whitespace largely is ignored, it does at times give markdown signals as to how to proceed. As a habit, try to keep everything left aligned whenever possible, especially as you type a new paragraph. In other words, there is no need to indent basic text in the Rmd document (in fact, it might cause your text to do funny things if you do).

### 2.1.2. Italics and bold

- *Italics* are done like `*this*` or `_this_`
- **Bold** is done like `**this**` or `__this__`
- ***Bold and italics*** is done like `***this***`, `___this___`, or (the most transparent solution, in my opinion) `**_this_**`

### 2.1.3. Inline code

- Inline code is created with backticks like ``this``

### 2.1.4. Sub and superscript

Sub<sub>2</sub> and super<sup>2</sup> script is created like `this~2~` and `this^2^`

### 2.1.5. Strikethrough

- ~~Strikethrough~~ is done `~~like this~~`

### 2.1.6. ‘Escaping’ (aka “What if I need an actual asterisk?”)

- To include an actual `*`, `_` or `\`, add another `\` in front of them: `\*`, `\_`, `\\`

### 2.1.7. Endash (–), emdash (—)

- `–` and `—` with `--` and `---`

### 2.1.8. Blockquotes

Do like this:

Put a > in front of the line.

### 2.1.9. Headings

Section headers are created with #'s of increasing number, i.e.

- # First-level heading
- ## Second-level heading
- ### Etc.

In PDF output, a level-five heading will turn into a paragraph heading, i.e. `\paragraph{My level-five heading}`, which appears as bold text on the same line as the subsequent paragraph.

### 2.1.10. Lists

Unordered list by starting a line with an \* or a -:

- Item 1
- Item 2

Ordered lists by starting a line with a number. Notice that you can mislabel the numbers and *Markdown* will still make the order right in the output:

1. Item 1
2. Item 2

To create a sublist, indent the values a bit (at least four spaces or a tab):

1. Item 1
2. Item 2
3. Item 3
  - Item 3a
  - Item 3b

## 2. R Markdown basics

### 2.1.11. Line breaks

The official *Markdown* way to create line breaks is by ending a line with more than two spaces.

Roses are red. Violets are blue.

This appears on the same line in the output, because we didn't add spaces after red.

Roses are red.

Violets are blue.

This appears with a line break because I added spaces after red.

I find this is confusing, so I recommend the alternative way: Ending a line with a backslash will also create a linebreak:

Roses are red.

Violets are blue.

To create a new paragraph, you put a blank line.

Therefore, this line starts its own paragraph.

### 2.1.12. Hyperlinks

- [This is a hyperlink](#) created by writing the text you want turned into a clickable link in `[square brackets followed by a](https://hyperlink-in-parentheses)`

### 2.1.13. Footnotes

- Are created<sup>1</sup> by writing either `^[my footnote text]` for supplying the footnote content inline, or something like `[a-random-footnote-label]` and supplying the text elsewhere in the format shown below <sup>2</sup>:

`[a-random-footnote-label]: This is a random test.`

### 2.1.14. Comments

To write comments within your text that won't actually be included in the output, use the same syntax as for writing comments in HTML. That is, `<!-- this will not be included in the output -->`.

---

<sup>1</sup>my footnote text

<sup>2</sup>This is a random test.

### 2.1.15. Math

The syntax for writing math is stolen from LaTeX. To write a math expression that will be shown **inline**, enclose it in dollar signs. - This: `$A = \pi*r^{2}$` Becomes:  $A = \pi * r^2$

To write a math expression that will be shown in a block, enclose it in two dollar signs.

This: `$$A = \pi*r^{2}$$`

Becomes:

$$A = \pi * r^2$$

To create numbered equations, put them in an ‘equation’ environment and give them a label with the syntax `(\#eq:label)`, like this:

```
\begin{equation}
  f\left(k\right) = \binom{n}{k} p^k(1-p)^{n-k}
  (\#eq:binom)
\end{equation}
```

Becomes:

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \quad (2.1)$$

For more (e.g. how to theorems), see e.g. the documentation on [bookdown.org](https://bookdown.org)

## 2.2. Executable code chunks

The magic of R Markdown is that we can add executable code within our document to make it dynamic.

We do this either as *code chunks* (generally used for loading libraries and data, performing calculations, and adding images, plots, and tables), or *inline code* (generally used for dynamically reporting results within our text).

The syntax of a code chunk is shown in Figure 2.1.

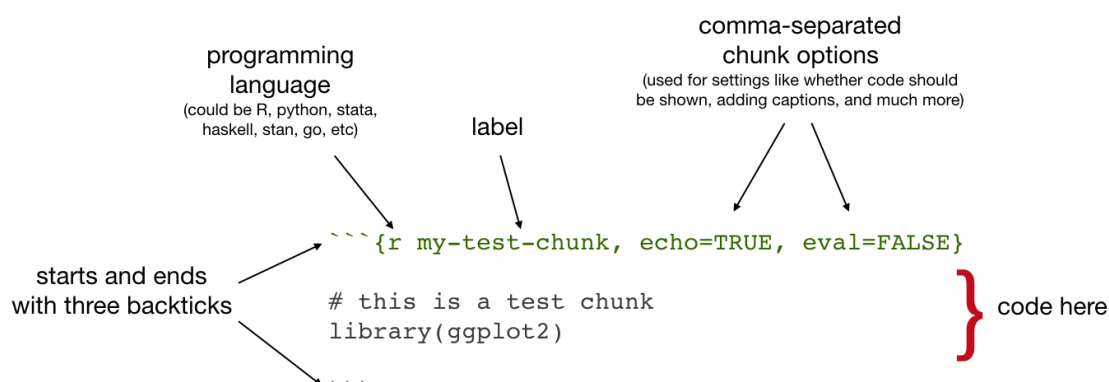


Figura 2.1: Code chunk syntax

Common chunk options include (see e.g. [bookdown.org](https://bookdown.org)):

## 2. R Markdown basics

- `echo`: whether or not to display code in knitted output
- `eval`: whether or to run the code in the chunk when knitting
- `include`: whether to include anything from the from a code chunk in the output document
- `fig.cap`: figure caption
- `fig.scap`: short figure caption, which will be used in the ‘List of Figures’ in the PDF front matter

**IMPORTANT:** Do *not* use underscores in your chunk labels - if you do, you are likely to get an error in PDF output saying something like “! Package caption Error: \caption outside float”.

### 2.2.1. Setup chunks - setup, images, plots

An R Markdown document usually begins with a chunk that is used to **load libraries**, and to **set default chunk options** with `knitr::opts_chunk$set`.

In your thesis, this will probably happen in **index.Rmd** and/or as opening chunks in each of your chapters.

```
‘‘‘{r setup, include=FALSE}
# don't show code unless we explicitly set echo = TRUE
knitr::opts_chunk$set(echo = FALSE)

library(tidyverse)
‘‘‘
```

### 2.2.2. Including images

Code chunks are also used for including images, with `include_graphics` from the `knitr` package, as in Figure 2.2

```
knitr::include_graphics("figures/sample-content/beltcrest.png")
```

Useful chunk options for figures include:

- `out.width` (use with a percentage) for setting the image size
- if you’ve got an image that gets waaay to big in your output, it will be constrained to the page width by setting `out.width = "100 %"`

### Figure rotation

You can use the chunk option `out.extra` to rotate images.

The syntax is different for LaTeX and HTML, so for ease we might start by assigning the right string to a variable that depends on the format you’re outputting to:



Figura 2.2: Oxford logo

```
if (knitr::is_latex_output()){
  rotate180 <- "angle=180"
} else {
  rotate180 <- "style='transform:rotate(180deg);'"
}
```

Then you can reference that variable as the value of `out.extra` to rotate images, as in Figure 2.3.

### 2.2.3. Including plots

Similarly, code chunks are used for including dynamically generated plots. You use ordinary code in R or other languages - Figure 2.4 shows a plot of the cars dataset of stopping distances for cars at various speeds (this dataset is built in to **R**).

```
cars %>%
  ggplot() +
  aes(x = speed, y = dist) +
  geom_point()
```

Under the hood, plots are included in your document in the same way as images - when you build the book or knit a chapter, the plot is automatically generated from your code, saved as an image, then included into the output document.

### 2.2.4. Including tables

Tables are usually included with the `kable` function from the `knitr` package.

## 2. R Markdown basics

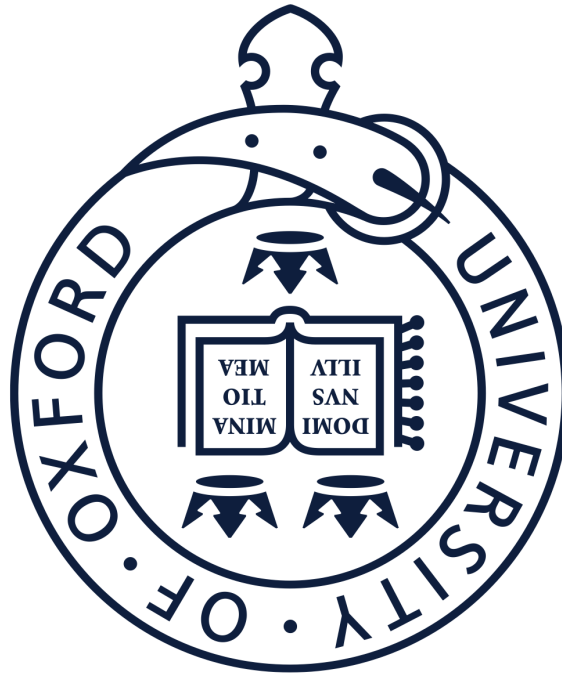


Figura 2.3: Oxford logo, rotated

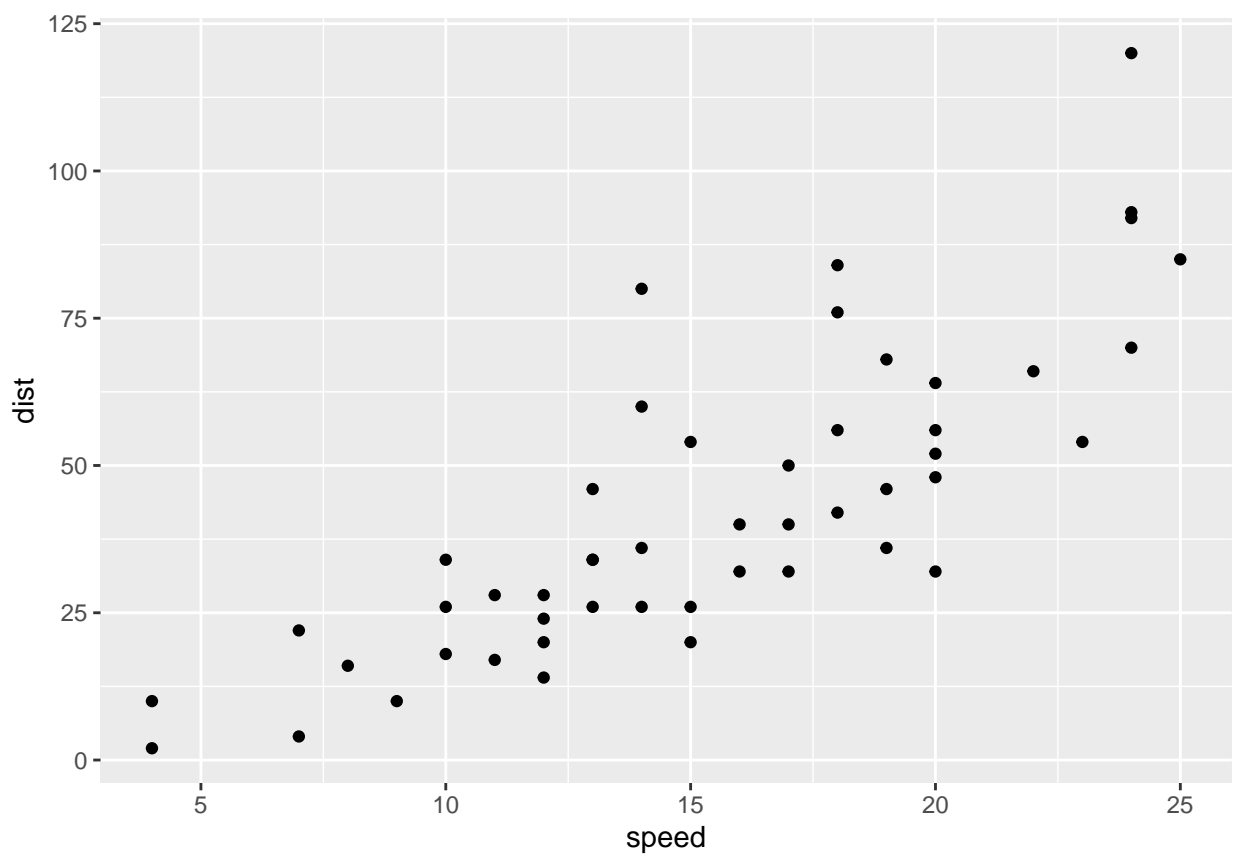


Figura 2.4: A ggplot of car stuff

Táboa 2.1: A knitr kable table

speed	dist
4	2
4	10
7	4
7	22
8	16
9	10

Table 2.1 shows the first rows of that cars data - read in your own data, then use this approach to automatically generate tables.

```
cars %>%
  head() %>%
  knitr::kable(caption = "A knitr kable table")
```

- Gotcha: when using `kable`, captions are set inside the `kable` function
- The `kable` package is often used with the `kableExtra` package

### 2.2.5. Control positioning

One thing that may be annoying is the way *R Markdown* handles “floats” like tables and figures. In your PDF output, LaTeX will try to find the best place to put your object based on the text around it and until you’re really, truly done writing you should just leave it where it lies.

In general, you should allow LaTeX to do this, but if you really *really* need a figure to be positioned where you put in the document, then you can make LaTeX attempt to do this with the chunk option `fig.pos="H"`, as in Figure 2.5:

```
knitr::include_graphics("figures/sample-content/beltcrest.png")
```





**Figura 2.5:** An Oxford logo that LaTeX will try to place at this position in the text

As anyone who has tried to manually play around with the placement of figures in a Word document knows, this can have lots of side effects with extra spacing on other pages, etc. Therefore, it is not generally a good idea to do this - only do it when you really need to ensure that an image follows directly under text where you refer to it (in this document, I needed to do this for Figure 4.1 in section 4.1.4). For more details, read the relevant section of the [R Markdown Cookbook](#).

## 2.3. Executable inline code

‘Inline code’ simply means inclusion of code inside text. The syntax for doing this is ``r R_CODE``. For example, ``r 4 + 4`` will output 8 in your text.

You will usually use this in parts of your thesis where you report results - read in data or results in a code chunk, store things you want to report in a variable, then insert the value of that variable in your text. For example, we might assign the number of rows in the `cars` dataset to a variable:

```
num_car_observations <- nrow(cars)
```

We might then write:

“In the `cars` dataset, we have ``r num_car_observations`` observations.”

Which would output:

“In the `cars` dataset, we have 50 observations.”

## 2.4. Executable code in other languages than R

If you want to use other languages than R, such as Python, Julia C++, or SQL, see [the relevant section of the \*R Markdown Cookbook\*](#)

# 3

## Citations, cross-references, and collaboration

### Índice

---

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---

### 3.1. Citations

The usual way to include citations in an *R Markdown* document is to put references in a plain text file with the extension **.bib**, in **BibTeX** format.<sup>1</sup> Then reference the path to this file in **index.Rmd**'s YAML header with `bibliography: example.bib`.

Most reference managers can create a `.bib` file with you references automatically. However, the **by far** best reference manager to use with *R Markdown* is [Zotero](#) with

---

<sup>1</sup>The bibliography can be in other formats as well, including EndNote (**.enl**) and RIS (**.ris**), see [rmarkdown.rstudio.com/authoring\\_bibliographies\\_and\\_citations](https://rmarkdown.rstudio.com/authoring_bibliographies_and_citations).

the [Better BibTeX plug-in](#), because the `citr` plugin for RStudio (see below) can read references directly from your Zotero library!

Here is an example of an entry in a **.bib** file:

```
@article{Shea2014,
  author = {Shea, Nicholas and Boldt, Annika},
  journal = {Trends in Cognitive Sciences},
  pages = {186--193},
  title = {{Supra-personal cognitive control}},
  volume = {18},
  year = {2014},
  doi = {10.1016/j.tics.2014.01.006},
}
```

In this entry highlighted section, ‘Shea2014’ is the **citation identifier**. To default way to cite an entry in your text is with this syntax: `[@citation-identifier]`.

So I might cite some things (Shea y col. 2014; Lottridge y col. 2012).

### 3.1.1. PDF output

In PDF output, the bibliography is handled by the OxThesis LaTeX template. If you set `bib-humanities: true` in **index.Rmd**, then in-text references will be formatted as author-year; otherwise references will be shown as numbers.

If you choose author-year formatting, a number of variations on the citation syntax are useful to know:

- Put author names outside the parenthesis
  - This: `@Shea2014` says blah.
  - Becomes: Shea y col. (2014) says blah.
- Include only the citation-year (in parenthesis)
  - This: Shea et al. says blah `[-@Shea2014]`
  - Becomes: Shea et al. says blah (2014)
- Add text and page or chapter references to the citation
  - This: `[see @Shea2014, pp. 33-35; also @Wu2016, ch. 1]`
  - Becomes: Blah blah (see Shea y col. 2014, pp. 33-35; also Wu 2016, ch. 1).

### 3.1.2. Gitbook output

In gitbook output, citations are by default inserted in the Chicago author-date format.

To change the format, add `cs1: some-other-style.cs1` in **index.Rmd**’s YAML header. You can browse through and download styles at [zotero.org/styles](https://www.zotero.org/styles).

### 3. Citations and cross-refs

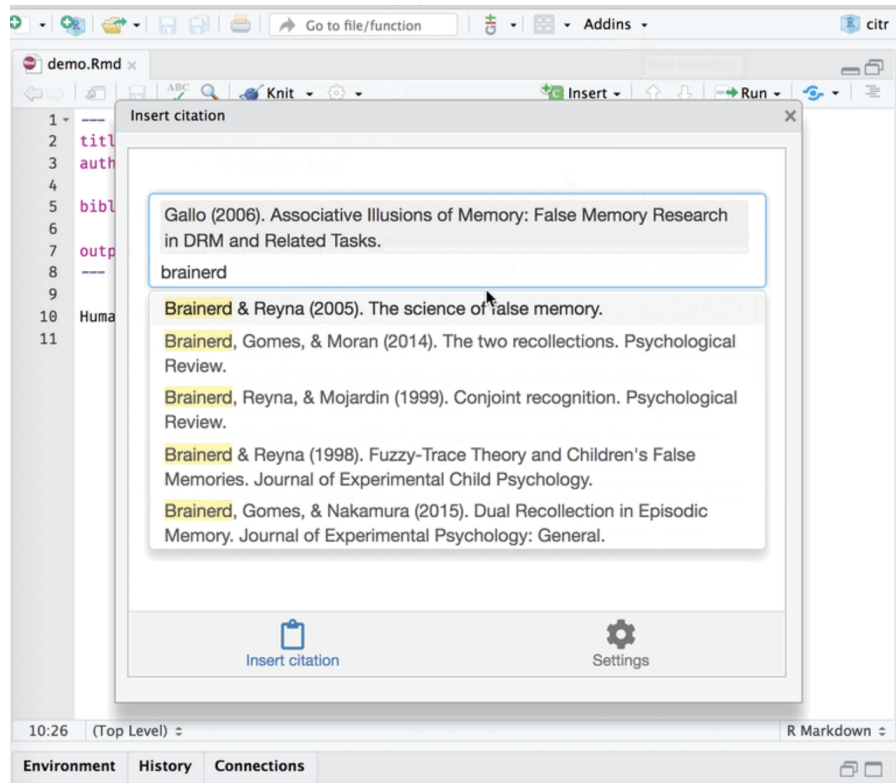


Figura 3.1: The 'citr' add-in

#### 3.1.3. Insert references easily with the **citr** add-in

For an easy way to insert citations, try the **citr** RStudio add-in (Figure 3.1). You can install this add-in by typing `install.packages("citr")` in the R Console.

## 3.2. Cross-referencing

We can make cross-references to **sections** within our document, as well as to **figures** (images and plots) and **tables**.

The general cross-referencing syntax is `\@ref(label)`

#### 3.2.1. Section references

Headers are automatically assigned a reference label, which is the text in lower caps separated by dashes. For example, `# My header` is automatically given the label `my-header`. So `# My header` can be referenced with `\@ref(my-section)`

Remember what we wrote in section 3.1?

We can also use **hyperlink syntax** and add `#` before the label, though this is only guaranteed to work properly in HTML output:

- So if we write `Remember what we wrote up in [the previous section](#citation)`
- It becomes `Remember what we wrote up in the previous section?`



Figura 3.2: A marvel-lous meme

### Creating custom labels

It is a very good idea to create **custom labels** for our sections. This is because the automatically assigned labels will change when we change the titles of the sections - to avoid this, we can create the labels ourselves and leave them untouched if we change the section titles.

We create custom labels by adding `{#label}` after a header, e.g. `# My section {#my-label}`. See our chapter title for an example. That was section 3.

#### 3.2.2. Figure (image and plot) references

- To refer to figures (i.e. images and plots) use the syntax `\@ref(fig:label)`
- **GOTCHA:** Figures and tables must have captions if you wish to cross-reference them.

Let's add an image:

```
knitr::include_graphics("figures/sample-content/captain.jpeg")
```

We refer to this image with `\@ref(fig:captain)`. So Figure 3.2 is this image. And in Figure 2.4 we saw a cars plot.

### 3. Citations and cross-refs

**Táboa 3.1:** Stopping cars

speed	dist
4	2
4	10
7	4
7	22
8	16

#### 3.2.3. Table references

- To refer to tables use the syntax `\@ref(tab:label)`

Let's include a table:

```
knitr::kable(cars[1:5, ],  
             caption="Stopping cars")
```

We refer to this table with `\@ref(tab:cars-table2)`. So Table 3.1 is this table. And in Table 2.1 we saw more or less the same cars table.

#### 3.2.4. Including page numbers

Finally, in the PDF output we might also want to include the page number of a reference, so that it's easy to find in physical printed output. LaTeX has a command for this, which looks like this: `\pageref{fig/tab:label}` (note: curly braces, not parentheses)

When we output to PDF, we can use raw LaTeX directly in our .Rmd files. So if we wanted to include the page of the cars plot we could write:

- This: `Figure \@ref(fig:cars-plot) on page \pageref(fig:cars-plot)`
- Becomes: Figure 2.4 on page 21

#### Include page numbers only in PDF output

A problem here is that LaTeX commands don't display in HTML output, so in the gitbook output we'd see simply "Figure 2.4 on page".

One way to get around this is to use inline R code to insert the text, and use an `ifelse` statement to check the output format and then insert the appropriate text.

- So this: ``r ifelse(knitr::is_latex_output(), "Figure \@ref(fig:cars-plot) on page \pageref{fig:cars-plot}", )``
- Inserts this (check this on both PDF and gitbook): Figure 2.4 on page 21

Note that we need to escape the backslash with another backslash here to get the correct output.

### 3.3. Collaborative writing

Best practices for collaboration and change tracking when using R Markdown are still an open question. In the blog post [One year to dissertate](#) by Lucy D’Agostino, which I highly recommend, the author notes that she knits .Rmd files to a word document, then uses the `googledrive` R package to send this to Google Drive for comments / revisions from co-authors, then incorporates Google Drive suggestions *by hand* into the .Rmd source files. This is a bit clunky, and there are ongoing discussions among the *R Markdown* developers about what the best way is to handle collaborative writing (see [issue #1463](#) on GitHub, where [CriticMarkup](#) is among the suggestions).

For now, this is an open question in the community of R Markdown users. I often knit to a format that can easily be imported to Google Docs for comments, then go over suggested revisions and manually incorporate them back in to the .Rmd source files. For articles, I sometimes upload a near-final draft to [Overleaf](#), then collaboratively make final edits to the LaTeX file there. I suspect some great solution will be developed in the not-to-distant future, probably by the RStudio team.

### 3.4. Additional resources

- *R Markdown: The Definitive Guide* - <https://bookdown.org/yihui/rmarkdown/>
- *R for Data Science* - <https://r4ds.had.co.nz>



# 4

## Tables

### Índice

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## 4.1. Making LaTeX tables play nice

Dealing with tables in LaTeX can be painful. This section explains the main tricks you need to make the pain go away.

(Note: if you are looking at the ebook version, you will not see much difference in this section, as it is only relevant for PDF output!)

### 4.1.1. Making your table pretty

When you use `kable` to create tables, you will almost certainly want to set the option `booktabs = TRUE`. This makes your table look a million times better:

```
library(knitr)
library(tidyverse)

head(mtcars) %>%
  kable(booktabs = TRUE)
```

#### 4.1. Making LaTeX tables play nice

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

Compare this to the default style, which looks terrible:

```
head(mtcars) %>%
  kable()
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

#### 4.1.2. If your table is too wide

You might find that your table expands into the margins of the page, like the tables above. Fix this with the `kable_styling` function from the `kableExtra` package:

```
library(kableExtra)

head(mtcars) %>%
  kable(booktabs = TRUE) %>%
  kable_styling(latex_options = "scale_down")
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

This scales down the table to fit the page width.

#### 4.1.3. If your table is too long

If your table is too long to fit on a single page, set `longtable = TRUE` in the `kable` function to split the table across multiple pages.

#### 4. Tables

```
a_long_table <- rbind(mtcars, mtcars)

a_long_table %>%
  select(1:8) %>%
  kable(booktabs = TRUE, longtable = TRUE)
```

	mpg	cyl	displacement	hp	drat	wt	qsec	vs
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1
Mazda RX41	21.0	6	160.0	110	3.90	2.620	16.46	0
Mazda RX4 Wag1	21.0	6	160.0	110	3.90	2.875	17.02	0
Datsun 7101	22.8	4	108.0	93	3.85	2.320	18.61	1

#### 4.1. Making LaTeX tables play nice

Hornet 4 Drive1	21.4	6	258.0	110	3.08	3.215	19.44	1
Hornet Sportabout1	18.7	8	360.0	175	3.15	3.440	17.02	0
Valiant1	18.1	6	225.0	105	2.76	3.460	20.22	1
Duster 3601	14.3	8	360.0	245	3.21	3.570	15.84	0
Merc 240D1	24.4	4	146.7	62	3.69	3.190	20.00	1
Merc 2301	22.8	4	140.8	95	3.92	3.150	22.90	1
Merc 2801	19.2	6	167.6	123	3.92	3.440	18.30	1
Merc 280C1	17.8	6	167.6	123	3.92	3.440	18.90	1
Merc 450SE1	16.4	8	275.8	180	3.07	4.070	17.40	0
Merc 450SL1	17.3	8	275.8	180	3.07	3.730	17.60	0
Merc 450SLC1	15.2	8	275.8	180	3.07	3.780	18.00	0
Cadillac Fleetwood1	10.4	8	472.0	205	2.93	5.250	17.98	0
Lincoln Continental1	10.4	8	460.0	215	3.00	5.424	17.82	0
Chrysler Imperial1	14.7	8	440.0	230	3.23	5.345	17.42	0
Fiat 1281	32.4	4	78.7	66	4.08	2.200	19.47	1
Honda Civic1	30.4	4	75.7	52	4.93	1.615	18.52	1
Toyota Corolla1	33.9	4	71.1	65	4.22	1.835	19.90	1
Toyota Corona1	21.5	4	120.1	97	3.70	2.465	20.01	1
Dodge Challenger1	15.5	8	318.0	150	2.76	3.520	16.87	0
AMC Javelin1	15.2	8	304.0	150	3.15	3.435	17.30	0
Camaro Z281	13.3	8	350.0	245	3.73	3.840	15.41	0
Pontiac Firebird1	19.2	8	400.0	175	3.08	3.845	17.05	0
Fiat X1-91	27.3	4	79.0	66	4.08	1.935	18.90	1
Porsche 914-21	26.0	4	120.3	91	4.43	2.140	16.70	0
Lotus Europa1	30.4	4	95.1	113	3.77	1.513	16.90	1
Ford Pantera L1	15.8	8	351.0	264	4.22	3.170	14.50	0
Ferrari Dino1	19.7	6	145.0	175	3.62	2.770	15.50	0
Maserati Bora1	15.0	8	301.0	335	3.54	3.570	14.60	0
Volvo 142E1	21.4	4	121.0	109	4.11	2.780	18.60	1

When you do this, you'll probably want to make the header repeat on new pages. Do this with the `kable_styling` function from `kableExtra`:

```
a_long_table %>%
  kable(booktabs = TRUE, longtable = TRUE) %>%
  kable_styling(latex_options = "repeat_header")
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2

#### 4. Tables

(continued)

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
Mazda RX4i	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag1	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710i	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive1	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout1	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant1	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360i	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240Di	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230i	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280i	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280Ci	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SEi	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SLi	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3

#### 4.1. Making LaTeX tables play nice

(continued)

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Merc 450SLC1	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood1	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental1	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial1	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 1281	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic1	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla1	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona1	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger1	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin1	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z281	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird1	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-91	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-21	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa1	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L1	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino1	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora1	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E1	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

Unfortunately, we cannot use the `scale_down` option with a `longtable`. So if a `longtable` is too wide, you can either manually adjust the font size, or show the table in landscape layout. To adjust the font size, use `kableExtra`'s `font_size` option:

```
a_long_table %>%
  kable(booktabs = TRUE, longtable = TRUE) %>%
  kable_styling(font_size = 9, latex_options = "repeat_header")
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4

#### 4. Tables

(continued)

	mpg	cyl	displacement	hp	drat	wt	qsec	vs	am	gear	carb
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
Mazda RX41	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag1	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 7101	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive1	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout1	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant1	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 3601	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D1	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 2301	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 2801	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C1	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE1	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL1	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC1	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood1	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental1	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial1	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 1281	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic1	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla1	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona1	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger1	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin1	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z281	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird1	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-91	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-21	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa1	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L1	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino1	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora1	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E1	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

To put the table in landscape mode, use `kableExtra`'s `landscape` function:

#### 4.1. Making LaTeX tables play nice

```
a_long_table %>%  
  kable(booktabs = TRUE, longtable = TRUE) %>%  
  kable_styling(latex_options = "repeat_header") %>%  
  landscape()
```



	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2

*(continued)*

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
Mazda RX41	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag1	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 7101	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive1	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout1	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant1	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 3601	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D1	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 2301	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 2801	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C1	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE1	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL1	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC1	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood1	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental1	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial1	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4

(continued)

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Fiat 1281	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic1	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla1	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona1	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger1	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin1	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z281	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird1	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-91	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-21	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa1	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L1	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino1	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora1	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E1	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

#### 4.1.4. Max power: manually adjust the raw LaTeX output

For total flexibility, you can adjust the raw LaTeX output from `kable/kableExtra` that generates the table. Let us consider how we would do this for the example of adjusting the font size if our table is too wide: LaTeX has a bunch of standard commands that set an approximate font size, as shown below in Figure 4.1.

<code>\tiny</code>	Lorem ipsum
<code>\scriptsize</code>	Lorem ipsum
<code>\footnotesize</code>	Lorem ipsum
<code>\small</code>	Lorem ipsum

**Figure 4.1:** Font sizes in LaTeX

You could use these to manually adjust the font size in your longtable in two steps:

1. Wrap the longtable environment in, e.g., a `scriptsize` environment, by doing a string replacement in the output from `kable/kableExtra`
2. Add the attributes that make R Markdown understand that the table is a table (it seems R drops these when we do the string replacement)

```
our_adjusted_table <- a_long_table %>%
  kable(booktabs = TRUE, longtable = TRUE) %>%
  kable_styling(latex_options = "repeat_header") %>%
  # wrap the longtable in a tiny environment
  str_replace('\\\\\\begin\\\\\\{longtable\\\\\\}',
              '\\\\\\begin\\\\\\{scriptsize\\\\\\}\\n\\\\\\begin\\\\\\{longtable\\\\\\}') %>%
  str_replace('\\\\\\end\\\\\\{longtable\\\\\\}',
              '\\\\\\end\\\\\\{longtable\\\\\\}\\n\\\\\\end\\\\\\{scriptsize\\\\\\}')

#add attributes to make R Markdown treat this as a kable LaTeX table again
our_adjusted_table %>%
  structure(format = "latex", class = "knitr_kable")
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1

#### 4. Tables

(continued)

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
Mazda RX41	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag1	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 7101	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive1	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout1	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant1	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 3601	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D1	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 2301	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 2801	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C1	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE1	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL1	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC1	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood1	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental1	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial1	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 1281	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic1	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla1	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona1	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger1	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin1	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z281	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird1	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-91	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-21	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa1	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L1	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino1	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora1	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E1	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

# 5

## Customisations and extensions

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This chapter describes a number of additional tips and tricks as well as possible customizations to the oxforddown thesis.

## 5.1. Front matter

### 5.1.1. Shorten captions shown in the list of figures (PDF)

You might want your list of figures (which follows the table of contents) to have shorter (or just different) figure descriptions than the actual figure captions.

Do this using the chunk option `fig.scap` ('short caption'), for example `{r captain-image, fig.cap=.^ very long and descriptive (and potentially boring) caption that doesn't fit in the list of figures, but helps the reader understand what the figure communicates.", fig.scap=.^ concise description for the list of figures"`

### 5.1.2. Shorten captions shown in the list of tables (PDF)

You might want your list of tables (which follows the list of figures in your thesis front matter) to have shorter (or just different) table descriptions than the actual table captions.

If you are using `knitr::kable` to generate a table, you can do this with the argument `caption.short`, e.g.:

```
knitr::kable(mtcars,
              caption = "A very long and descriptive (and potentially
                          boring) caption that doesn't fit in the list of figures,
                          but helps the reader understand what the figure
                          communicates.",
              caption.short = "A concise description for the list of tables")
```

## 5.2. Shorten running header (PDF)

You might want a chapter's running header (i.e. the header showing the title of the current chapter at the top of page) to be shorter (or just different) to the actual chapter title.

Do this by adding the latex command `\chaptermark{My shorter version}` after your chapter title.

For example, chapter 3's running header is simply 'Cites and cross-refs', because it begins like this:

```
# Citations, cross-references, and collaboration {#cites-and-refs}
\chaptermark{Cites and cross-refs}
```

## 5.3. Unnumbered chapters

To make chapters unnumbered (normally only relevant to the Introduction and/or the Conclusion), follow the chapter header with `{-}`, e.g. `# Introduction {-}`.

When you do this, you must also follow the heading with these two latex commands:

```
\adjustmtc
\markboth{The Name of Your Unnumbered Chapter}{{}}
```

Otherwise the chapter's mini table of contents and the running header will show the previous chapter.

## 5.4. Beginning chapters with quotes (PDF)

The OxThesis LaTeX template lets you inject some wittiness into your thesis by including a block of type `savequote` at the beginning of chapters. To do this, use the syntax ````{block type='savequote'}````.<sup>1</sup>

Add the reference for the quote with the chunk option `quote_author="my author name"`. You will also want to add the chunk option `include=knitr::is_latex_output()` so that quotes are only included in PDF output.

It's not possible to use markdown syntax inside chunk options, so if you want to e.g. italicise a book name in the reference use a '[text reference](#)': Create a named piece of text with `'(ref:label-name) My text'`, then point to this in the chunk option with `quote_author='(ref:label-name)'`.

## 5.5. Highlighting corrections (HTML & PDF)

For when it comes time to do corrections, you may want to highlight changes made when you submit a post-viva, corrected copy to your examiners so they can quickly verify you've completed the task. You can do so like this:

### 5.5.1. Short, inline corrections

Highlight **short, inline corrections** by doing `[like this]{.correction}` — the text between the square brackets will then **be highlighted in blue** in the output.

Note that pandoc might get confused by citations and cross-references inside inline corrections. In particular, it might get confused by `"[what @Shea2014 said]{.correction}"` which becomes `(what Shea y col. 2014, said){.correction}` In such cases, you can use LaTeX syntax directly. The correction highlighting uses the [soul](#) package, so you can do like this:

- If using biblatex for references, use `"\hl{what \textcite{Shea2014} said}"`
- If using natbib for references, use `"\hl{what \cite{Shea2014} said}"`

<sup>1</sup>For more on custom block types, see the relevant section in [Authoring Books with R Markdown](#).



## 5. Customisations and extensions

Using raw LaTeX has the drawback of corrections then not showing up in HTML output at all, but you might only care about correction highlighting in the PDF for your examiners anyway!

### 5.5.2. Blocks of added or changed material

Highlight entire **blocks of added or changed material** by putting them in a block of type `correction`, using the syntax ````{block type='correction'}````.<sup>2</sup> Like so:

For larger chunks, like this paragraph or indeed entire figures, you can use the `correction` block type. This environment **highlights paragraph-sized and larger blocks** with the same blue colour.

*Note that correction blocks cannot be included in word output.*

### 5.5.3. Stopping corrections from being highlighted

To turn off correction highlighting, go to the YAML header of `index.Rmd`, then:

- PDF output: set `corrections: false`
- HTML output: remove or comment out `templates/corrections.css`

## 5.6. Apply custom font color and highlighting to text (HTML & PDF)

The lua filter that adds the functionality to highlight corrections adds two more tricks: you can apply your own choice of colour to highlight text, or change the font color. The syntax is as follows:

Here's [some text in pink highlighting]{highlight="pink"}  
Becomes: Here's **some text in pink highlighting**.

[Here's some text with blue font]{color="blue"}  
Becomes: **Here's some text with blue font**

Finally – never, ever actually do this – [here's some text with black highlighting and yellow font]{highlight="black" color="yellow"}  
Becomes: **here's some text with black highlighting and yellow font**

The file `scripts_and_filters/colour_and_highlight.lua` implements this, if you want to fiddle around with it. It works with both PDF and HTML output.

<sup>2</sup>In the `.tex` file for PDF output, this will put the content between `\begin{correction}` and `\end{correction}`; in gitbook output it will be put between `<div class=correction>` and `</div>`.

## 5.7. Including another paper in your thesis - embed a PDF document

You may want to embed existing PDF documents into the thesis, for example if your department allows a ‘portfolio’ style thesis and you need to include an existing typeset publication as a chapter.

In gitbook output, you can simply use `knitr::include_graphics` and it should include a scrollable (and downloadable) PDF. You will probably want to set the chunk options `out.width='100%'` and `out.height='1000px'`:

```
knitr::include_graphics("figures/sample-content/pdf_embed_example/Lyngs2020_FB.p
```

In LaTeX output, however, this approach can cause odd behaviour. Therefore, when you build your thesis to PDF, split the PDF into an alphanumerically sorted sequence of **single-page** PDF files (you can do this automatically with the package `pdftools`). You can then use the appropriate LaTeX command to insert them, as shown below (for brevity, in the `oxforddown` PDF sample content we’re only including two pages). *Note that the chunk option `results='asis'` must be set.* You may also want to remove margins from the PDF files, which you can do with Adobe Acrobat (paid version) and likely other software.

```
# install.packages(pdftools)
# split PDF into pages stored in
  figures/sample-content/pdf_embed_example/split/
#
  pdftools::pdf_split("figures/sample-content/pdf_embed_example/Lyngs2020_FB.p
# output = "figures/sample-content/pdf_embed_example/split/")

# grab the pages
pages <- list.files("figures/sample-content/pdf_embed_example/split",
  full.names = TRUE)

# set how wide you want the inserted PDFs to be:
# 1.0 is 100 per cent of the oxforddown PDF page width;
# you may want to make it a bit bigger
pdf_width <- 1.2

# for each PDF page, insert it nicely and
# end with a page break
cat(stringr::str_c("\\newpage \\begin{center}
  \\makebox[\\linewidth][c]{\\includegraphics[width=", pdf_width,
  "\\linewidth]{", pages, "}} \\end{center}"))
```

# ‘I Just Want to Hack Myself to Not Get Distracted’: Evaluating Design Interventions for Self-Control on Facebook

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## ABSTRACT

Beyond being the world’s largest social network, Facebook is for many also one of its greatest sources of digital distraction. For students, problematic use has been associated with negative effects on academic achievement and general wellbeing. To understand what strategies could help users regain control, we investigated how simple interventions to the Facebook UI affect behaviour and perceived control. We assigned 58 university students to one of three interventions: goal reminders, removed newsfeed, or white background (control). We logged use for 6 weeks, applied interventions in the middle weeks, and administered fortnightly surveys. Both goal reminders and removed newsfeed helped participants stay on task and avoid distraction. However, goal reminders were often annoying, and removing the newsfeed made some fear missing out on information. Our findings point to future interventions such as controls for adjusting types and amount of available information, and flexible blocking which matches individual definitions of ‘distraction’.

## Author Keywords

Facebook; problematic use; self-control; distraction; ICT non-use; addiction; focus; interruptions

## CCS Concepts

•Human-centered computing → Empirical studies in HCI;

## INTRODUCTION

Research on ‘Problematic Facebook Use’ (PFU) has investigated correlations between Facebook use and negative effects on outcomes such as level of academic achievement [35] and subjective wellbeing [58, 57]. A cross-cutting finding is that negative outcomes are associated with difficulty at exerting self-control over use, as well as specific use patterns including viewing friends’ wide-audience broadcasts rather than receiving targeted communication from strong ties [13, 58].

Much of this work has focused on self-control over Facebook use in student populations [2, 44, 46], with media multitasking research finding that students often give in to use which provides short-term ‘guilty pleasures’ over important, but aversive academic tasks [76, 88, 60]. In the present paper, we present a mixed-methods study exploring how two interventions to Facebook — goal reminders and removing the newsfeed — affect university students’ patterns of use and perceived control over Facebook use. To triangulate self-report with objective measurement, our study combined usage logging with fortnightly surveys and post-study interviews.

We found that both interventions helped participants stay on task and use Facebook more in line with their intentions. In terms of use patterns, goal reminders led to less scrolling, fewer and shorter visits, and less time on site, whereas removing the newsfeed led to less scrolling, shorter visits, and less content ‘liked’. However, goal reminders were often experienced as annoying, and removing the newsfeed made some participants fear missing out on information. After the study, participants suggested a range of design solutions to mitigate self-control struggles on Facebook, including controls for filtering or removing the newsfeed, reminders of time spent and of use goals, and removing features that drive engagement. As an exploratory study, this work should be followed by confirmatory studies to assess whether our findings replicate, and how they may generalise beyond a student population.

## RELATED WORK

### Struggles with Facebook use

Whereas many uses of Facebook offer important benefits, such as social support, rapid spread of information, or facilitation of real-world interactions [78], a substantial amount of research has focused on negative aspects [58]. For example, studies have reported correlations between patterns of Facebook use and lower academic achievement [77, 86], low self-esteem, depression and anxiety [51], feelings of isolation and loneliness [2], and general psychological distress [15]. Such ‘Problematic Facebook Use’ (PFU) has been studied under various names (including ‘Facebook dependence’ [87] and ‘Facebook addiction’ [5]), but a recent review summarised a common definition as ‘problematic behaviour characterised by addictive-like symptoms and/or self-regulation difficulties related to Facebook use leading to negative consequences in personal and social life’ [58].

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CHI ’20, April 25–30, 2020, Honolulu, HI, USA.  
© 2020 Copyright is held by the author/owner(s).  
ACM ISBN 978-1-4503-6708-0/20/04.  
<http://dx.doi.org/10.1145/3313831.3376672>

## 5.7. Including another paper in your thesis - embed a PDF document

CHI 2020 Paper

CHI 2020, April 25–30, 2020, Honolulu, HI, USA

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## 5.8. Including another paper in your thesis - R Markdown child document

Sometimes you want to include another paper you are currently writing as a chapter in your thesis. Above 5.7, we described the simplest way to do this: include the other paper as a pdf. However, in some cases you instead want to include the R Markdown source from this paper, and have it compiled within your thesis. This is a little bit more tricky, because you need to keep careful track of your file paths, but it is possible by [including the paper as a child document](#). There are four main steps:

1. Include the paper as a child document
2. Make file paths compatible with knitting the article on its own, as well as when it's include in your thesis
3. Make header levels correct
4. Make figure widths correct

### 5.8.1. An example paper in another folder

Take this simple example (files for this are in [this GitHub repository](#)):

```
| --paper_to_include  
|   |--my_paper.Rmd  
|   |--data  
|     |--cat_salt.csv  
|     |--figures  
|       |--cat.jpg  
|  
|--thesis
```

As the chart suggests, you have another folder, **paper\_to\_include/** living in the same containing folder as your thesis folder. In the **paper\_to\_include** folder, the file **my\_paper.Rmd** is where you write the paper. In **my\_paper.Rmd**, you read in a CSV file found in the subfolder **data/cats.csv**, and also an image from the subfolder **figures/cat.jpg**.

### 5.8.2. Step 1: Include paper as a child document

In your thesis folder, create an Rmd file for the chapter where you want to include another paper. Add one or more code chunks that include R Markdown files from that paper as child documents:

```
# Including an external chapter  
  
````{r child = "../paper_to_include/my_paper.Rmd"}```  
````
```

### 5.8.3. Step 2: Make file paths compatible

Use `parameters` to adjust the file path of images based on values you set in the YAML header of an R Markdown file. In `my_paper.Rmd`, create a parameter called `other_path` and set it to an empty string:

```
---
title: "A fabulous article in a different folder"
params:
  other_path: ""
---
```

In `my_paper.Rmd`, put this at the start of the filepath when you read in data or include images:

```
library(tidyverse)
library(knitr)

cat_data <- read_csv(str_c(params$other_path, "data/cats.csv"))
include_graphics(str_c(params$other_path, "figures/cat.jpg"))
```

Finally, in your thesis folder's `index.Rmd` file, also create the parameter `other_path`. But here, set it to where the `paper_to_include/` folder is relative to your thesis folder:

```
params:
  other_path: "../paper_to_include/"
```

#### Note on HTML output

Note that if you want to host an HTML version on your thesis online, you will need to include graphics in the content that you host online - the internet obviously won't be able to see filepaths that are just referring to stuff in another folder on your computer!

### 5.8.4. Step 3: Make sure header levels are correct

Unless the paper you want to include is also written as a book, your header levels are probably going to be off. That is, the level 1 headers (`# Some header`) you use for main sections in the other paper turns into chapter titles when included in your thesis.

To avoid this, first *increment all heading levels by one* in `paper_to_include/my_paper.Rmd` (`# Some header -> ## Some header`). Then in `paper_to_include/` create a `lua filter` that decrements header levels by one: Create a text file, save it as `reduce_header_level.lua`, and give it the content below.

```
function Header(el)
  if (el.level <= 1) then
    error("I don't know how to decrease the level of h1")
  end
  el.level = el.level - 1
  return el
end
```

## 5. Customisations and extensions

In the YAML header of **paper\_to\_include/my\_paper.Rmd**, use this filter:

```
---
title: "A fabulous article in a different folder"
params:
  other_path: ""
output:
  pdf_document:
    pandoc_args: ["--lua-filter=reduce_header_level.lua"]
---
```

Now, your header levels will be correct both when you knit the paper on its own and when its included in your thesis.

NOTE: There might be no need to use a lua filter to shift heading - it seems you could simply use `pandoc_args: [-shift-heading-level-by=-1]` (see <https://pandoc.org/MANUAL.html#reader-options>)

### 5.8.5. Step 4. Make sure figure widths are correct

It might be that your figure widths when knitting your paper on its own, and when including it in your thesis, need to be different. You can again use parameters to set figure widths.

Imagine you want figure width to be 80 % of the page width when knitting your paper on its own, but 100 % in your thesis. In **paper\_to\_include/my\_paper.Rmd**, first add a parameter we could call `out_width` and set it to the string "80 %":

```
---
title: "A fabulous article in a different folder"
params:
  other_path: ""
  out_width: "80 %"
output:
  pdf_document:
    pandoc_args: ["--lua-filter=reduce_header_level.lua"]
---
```

Then, make sure use that parameter to set the output width when you include figures in **paper\_to\_include/my\_paper.Rmd**:

```
```{r, out.width=params$out_width, fig.cap="A very funny cat"}
include_graphics(str_c(params$other_path, "figures/cat.jpg"))
```
```

Finally, create the parameter `out_width` in your thesis' **index.Rmd** file:

```
params:
  other_path: "../paper_to_include/"
  out_width: "80 %"
```

Now, the output width of your figure will be 80 % when knitting your paper on its own, and 100 % when knitting it as child document of your thesis.

## 5.9. Customizing referencing

### 5.9.1. Using a .csl file with pandoc instead of biblatex

The `oxforddown` package uses `biblatex` in LaTeX for referencing. It is also possible to use `pandoc` for referencing by providing a `.csl` file in the YAML header of `index.Rmd` (likely requiring commenting out the `biblatex` code in `templates/template.tex`). This may be helpful for those who have a `.csl` file describing the referencing format for a particular journal. However, note that this approach does not support chapter bibliographies (see Section 5.9.2).

```
csl: ecology.csl
```

### 5.9.2. Customizing biblatex and adding chapter bibliographies

This section provides one example of customizing `biblatex`. Much of this code was combined from searches on Stack Exchange and other sources (e.g. [here](#)).

In `templates/template.tex`, one can replace the existing `biblatex` calls with the following to achieve referencing that looks like this:

(Charmantier and Gienapp 2014)

Charmantier, A. and P. Gienapp (2014). Climate change and timing of avian breeding and migration: evolutionary versus plastic changes. *Evolutionary Applications* 7(1):15–28. doi: 10.1111/eva.12126.

```
\usepackage[backend=biber,
  bibencoding=utf8,
  refsection=chapter, % referencing by chapter
  style=authoryear,
  firstinits=true,
  isbn=false,
  doi=true,
  url=false,
  eprint=false,
  related=false,
  dashed=false,
  clearlang=true,
  maxcitenames=2,
  mincitenames=1,
  maxbibnames=10,
  abbreviate=false,
  minbibnames=3,
  uniquelist=minyear,
  sortcites=true,
  date=year
]{biblatex}
\AtEveryBibitem{ %
  \clearlist{language} %
```



## 5. Customisations and extensions

```
\clearfield{note}
}

\DeclareFieldFormat{titlecase}{\MakeTitleCase{#1}}

\newrobustcmd{\MakeTitleCase}[1]{%
  \ifthenelse{\ifcurrentfield{booktitle}\OR\ifcurrentfield{booksubtitle}%
    \OR\ifcurrentfield{maintitle}\OR\ifcurrentfield{mainsubtitle}%
    \OR\ifcurrentfield{journaltitle}\OR\ifcurrentfield{journalsubtitle}%
    \OR\ifcurrentfield{issuetitle}\OR\ifcurrentfield{issuesubtitle}%
    \OR\ifentrytype{book}\OR\ifentrytype{mvbook}\OR\ifentrytype{bookinbook}%
    \OR\ifentrytype{booklet}\OR\ifentrytype{suppbook}%
    \OR\ifentrytype{collection}\OR\ifentrytype{mvcollection}%
    \OR\ifentrytype{suppcollection}\OR\ifentrytype{manual}%
    \OR\ifentrytype{periodical}\OR\ifentrytype{suppperiodical}%
    \OR\ifentrytype{proceedings}\OR\ifentrytype{mvproceedings}%
    \OR\ifentrytype{reference}\OR\ifentrytype{mvreference}%
    \OR\ifentrytype{report}\OR\ifentrytype{thesis}}
  {#1}
  {\MakeSentenceCase{#1}}}

% \renewbibmacro{in:}{}
% suppress "in" for articles
%
\renewbibmacro{in:}{%
  \ifentrytype{article}{}{\printtext{\bibstring{in}\intitlepunct}}
  %-- no "quotes" around titles of chapters/article titles
\DeclareFieldFormat[article, inbook, incollection, inproceedings, misc, thesis]{title}{#1}
  %-- no punctuation after volume
\DeclareFieldFormat[article]{volume}{{#1}}
  %-- puts number/issue between brackets
\DeclareFieldFormat[article, inbook, incollection, inproceedings, misc, thesis]{number}{\mkbibparens{#1}}
  %-- and then for articles directly the pages w/o any "pages" or "pp."
\DeclareFieldFormat[article]{pages}{#1}
  %-- for some types replace "pages" by "p."
\DeclareFieldFormat[inproceedings, incollection, inbook]{pages}{p. #1}
  %-- format 16(4):224--225 for articles
\renewbibmacro*{volume+number+eid}{
  \printfield{volume}%
  \printfield{number}%
```

```
\printunit{\addcolon}  
}
```

If you would like chapter bibliographies, in addition insert the following code at the end of each chapter, and comment out the entire REFERENCES section at the end of `template.tex`.

```
\printbibliography[segment=\therefsection,heading=subbibliography]
```

## 5.10. Customizing the page headers and footers (PDF)

This can now be done directly in `index.Rmd`'s YAML header. If you are a LaTeX expert and need further customisation that what's currently provided, you can tweak the relevant sections of `templates/template.tex` - the relevant code is beneath the line that begins `\usepackage{fancyhdr}`.

## 5.11. Diving in to the OxThesis LaTeX template (PDF)

For LaTeX minded people, you can read through `templates/template.tex` to see which additional customisation options are available as well as `templates/ociamthesis.cls` which supplies the base class. For example, `template.tex` provides an option for master's degree submissions, which changes identifying information to candidate number and includes a word count. At the time of writing, you must set this directly in `template.tex` rather than from the YAML header in `index.Rmd`.

## 5.12. Customising to a different university

### 5.12.1. The minimal route

If the front matter in the OxThesis LaTeX template is suitable to your university, customising oxforddown to your needs could be as simple as putting the name of your institution and the path to your university's logo in `index.Rmd`:

```
university: University of You  
university-logo: figures/your-logo-here.pdf
```

### 5.12.2. Replacing the entire title page with your required content

If you have a `.tex` file with some required front matter from your university that you want to replace the OxThesis template's title page altogether, you can provide a filepath to this file in `index.Rmd`. oxforddown's sample content includes an example of this — if you use the YAML below, your front matter will look like this:

5. Customisations and extensions

alternative-title-page: front-and-back-matter/alt-title-page-example.tex

|  |   |   |
|--|---|---|
| <p>Title of your Thesis</p> <p>John Doe</p>  | <p><b>Thesis committee</b></p> <p><b>Promotor:</b><br/>Prof. Dr. J. Smith<br/>Professor of Geo-information Science and Remote Sensing<br/>Wageningen University</p> <p><b>Co-promotors:</b><br/>Dr. Name of co-promotor<br/>Assistant Professor, Laboratory of Geo-information Science and Remote Sensing<br/>Wageningen University</p> <p><b>Other members:</b><br/>Prof. Dr. Jury member 1, Wageningen University<br/>Prof. Dr. Jury member 2, Affiliation<br/>Prof. Dr. Jury member 3, Affiliation<br/>Prof. Dr. Jury member 4, Affiliation</p> <p>This research was conducted under the auspices of the C.T. de Wit Graduate School of Production Ecology &amp; Resource Conservation (PE&amp;RC)</p> | <p>Title of your thesis</p> <p>John Doe</p> <p><b>Thesis</b><br/>submitted in fulfillment of the requirements for the degree of doctor at<br/>Wageningen University<br/>by the authority of the Rector Magnificus<br/>Prof. Dr. A.P.J. Mol,<br/>in the presence of the<br/>Thesis Committee appointed by the Academic Board<br/>to be defended in public<br/>on Date of your defense<br/>at 4 p.m. in the Aula.</p>   |
| <p>John Doe<br/>Title of your thesis<br/>77 pages<br/>PhD thesis, Wageningen University, Wageningen, NL (2015)<br/>With references, with summary in English<br/>ISBN XXX-YYY</p> | <p>For Yihui Xie</p>  | <p><b>Acknowledgements</b></p> <p>This is where you will normally thank your advisor, colleagues, family and friends, as well as funding and institutional support. In one case, we will give our gratitude to the people who developed the ideas and tools that allow us to push open science a little step forward by writing plain-text, transparent, and reproducible documents in R Markdown.</p> <p>We must be grateful to John Gruber for inventing the original version of Markdown, to John MacFarlane for creating Pandoc (<a href="http://pandoc.org">http://pandoc.org</a>) which converts Markdown to a large number of output formats, and to Yihui Xie for creating knitr which introduced R Markdown as a way of embedding code in Markdown documents, and bookdown which added tools for technical and longer-form writing.</p> <p>Special thanks to Chester Ismay, who created the thearistidean package that helped many a PhD student write their thesis in R Markdown. And a very special thanks to John McManis, whose adaptation of Sam Emsw's adaptation of Keith Gilbre's original maths template for writing an Oxford University DPhil thesis in LaTeX provided the template that I in turn adapted for R Markdown.</p> <p>Finally, profuse thanks to JJ Allaire, the founder and CEO of RStudio, and Hadley Wickham, the mastermind of the tidyverse without whom we'd all just give up and store data science in Python instead. Thanks for making data science easier, more accessible, and more fun for us all.</p> <p>Ullak Lyaga<br/>Linacre College, Oxford<br/>2 December 2018</p> |

# 6

## Troubleshooting

This chapter describes common errors you may run into, and how to fix them.

### 6.1. Error: Failed to build the bibliography via biber

This can happen if you've had a failed build, perhaps in relation to RStudio shutting down abruptly.

Try doing this:

1. type `make clean-knits` in the terminal tab (or run `file.remove(list.files(pattern = "*. (log|mtc|maf|aux|bbl|blg|xml)"))` in the R console) to clean up files generated by LaTeX during a build
2. restart your computer

If this does not solve the problem, try using the [natbib](#) LaTeX package instead of [biblatex](#) for handling references. To do this, go to **index.Rmd** and

1. set `use-biblatex: false` and `use-natbib: true`
2. set `citation_package: natbib` under

```
output:
  bookdown::pdf_book:
    citation_package: natbib
```

# 7

## Unidade 7

# 8

## Unidade 8

# 9

## Unidade 9

# 10

## Unidade 10



# **Appendices**





## The First Appendix

This first appendix includes an R chunk that was hidden in the document (using `echo = FALSE`) to help with readability:

**In 02-rmd-basics-code.Rmd**

```
library(tidyverse)
knitr::include_graphics("figures/sample-content/chunk-parts.png")
```

**And here's another one from the same chapter, i.e. Chapter 2.2:**

```
knitr::include_graphics("figures/sample-content/beltcrest.png")
```

B

The Second Appendix, for Fun

# Bibliografía

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