Intro to RMarkdown

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November 2, 2015

Motivation

New Workflow

Other Tools

Learning More

Motivation

Old Workflow - R to LaTeX

1. Do some cool stuff in R:

```
mod1 <- lm(mpg~hp, data = mtcars)
with(mtcars, plot(mpg~hp))
abline(mod1)
summary(mod1)
```

2. Copy/save the output/figure.
3. Paste into Latex document:

```
\begin{verbatim}
mod1 <- lm(mpg~hp, data = mtcars)
...
\includegraphics{figures/mpg.pdf}
```

Old Workflow - Problems

- What if we need to make a change?
- Latex is hard and requires a lot of boilerplate.
- Distracting: doesn't facilitate higher-order thinking.

Reproducibility

- If I win the lottery and drop out of graduate school, could someone else pick up where I left off?
- How long would it take them to do so?

Interactivity

- We live in the future. Why should our documents be static?
- Interactive documents are useful to everyone: ourselves, our students, executives, etc.

New Workflow

New Workflow - Unified Document

1. Do some cool stuff in RMarkdown.
2. Push button.
3. Get PDF.

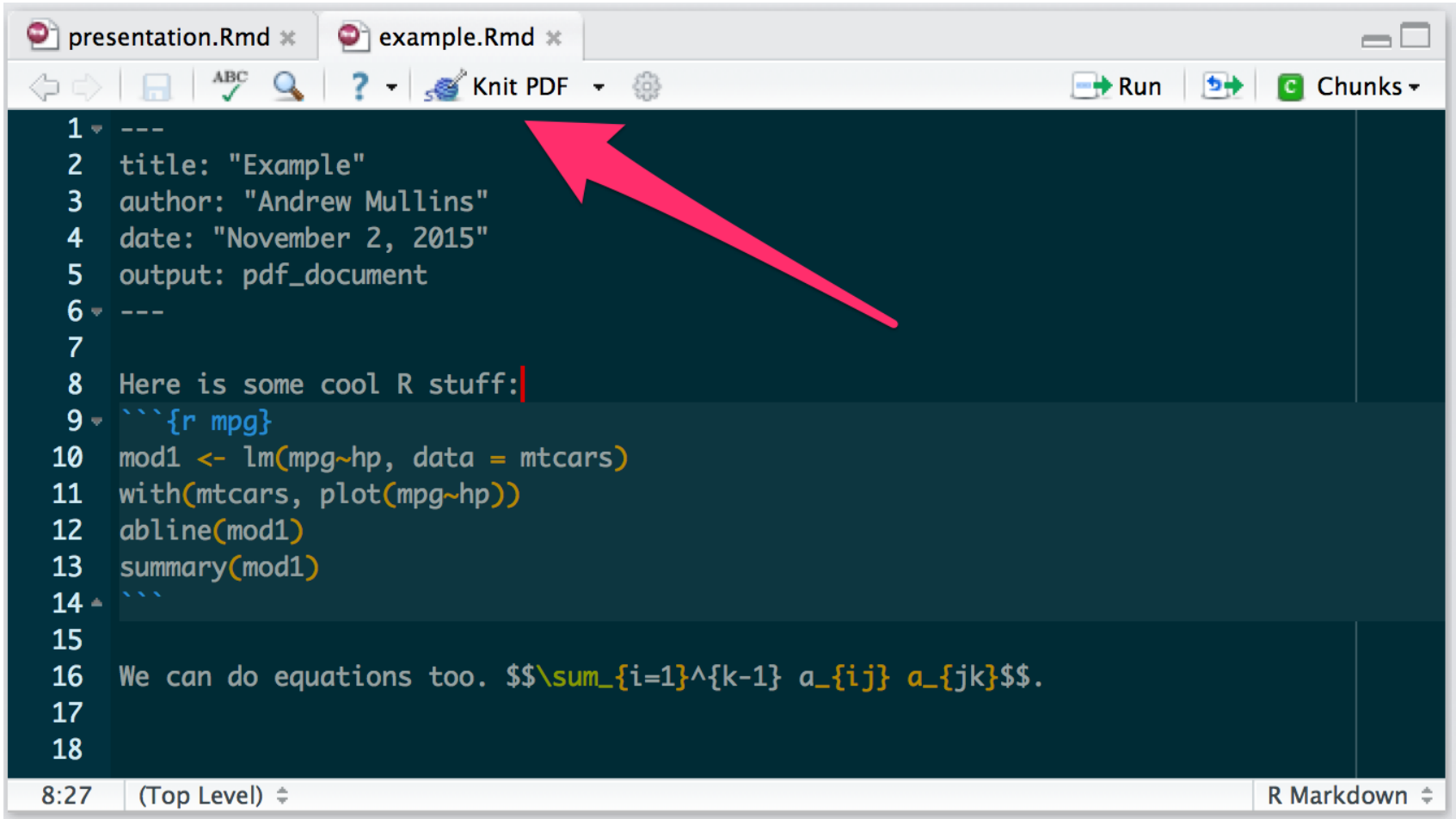
New Workflow - Write Code

```
---
title: "Example"
author: "Andrew Mullins"
date: "November 2, 2015"
output: pdf_document
---

Here is some cool R stuff:
```{r mpg}
mod1 <- lm(mpg~hp, data = mtcars)
with(mtcars, plot(mpg~hp))
abline(mod1)
summary(mod1)
```

We can do equations too. $$\sum_{i=1}^{k-1} a_{ij} a_{jk}$$.
```

New Workflow - Push Button



New Workflow - Get PDF 1

Example

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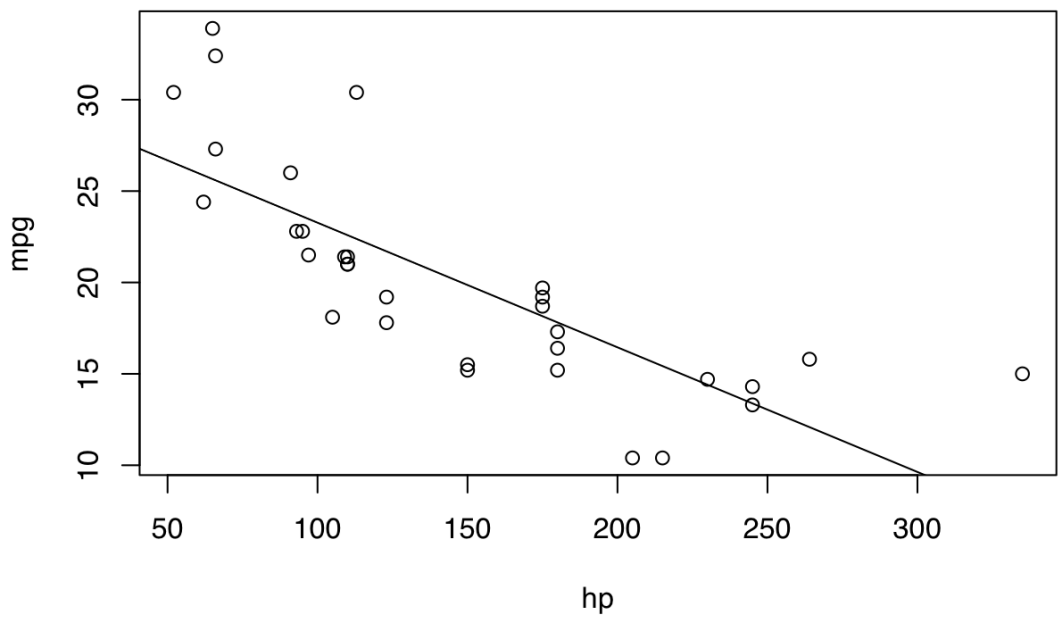
Here is some cool R stuff:

```
mod1 <- lm(mpg~hp, data = mtcars)
with(mtcars, plot(mpg~hp))
abline(mod1)
```



New Workflow - Get PDF 2

```
summary(mod1)
```

```
##
## Call:
## lm(formula = mpg ~ hp, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.7121 -2.1122 -0.8854  1.5819  8.2360
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
```



```
## (Intercept) 30.09886    1.63392  18.421  < 2e-16 ***
## hp          -0.06823    0.01012  -6.742 1.79e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.863 on 30 degrees of freedom
## Multiple R-squared:  0.6024, Adjusted R-squared:  0.5892
## F-statistic: 45.46 on 1 and 30 DF,  p-value: 1.788e-07
```

New Workflow - Get PDF 3

We can do equations too:

$$\sum_{i=1}^{k-1} a_{ij} a_{jk}$$

.

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

New Workflow - Make a change

Just change it in one place and press button.

Other Tools

Sweave

Problem: Sometimes we need the fine-tuned control you can get with Latex.

Solution: Sweave let's use get both the power of Latex while still being able to use in-line R code.

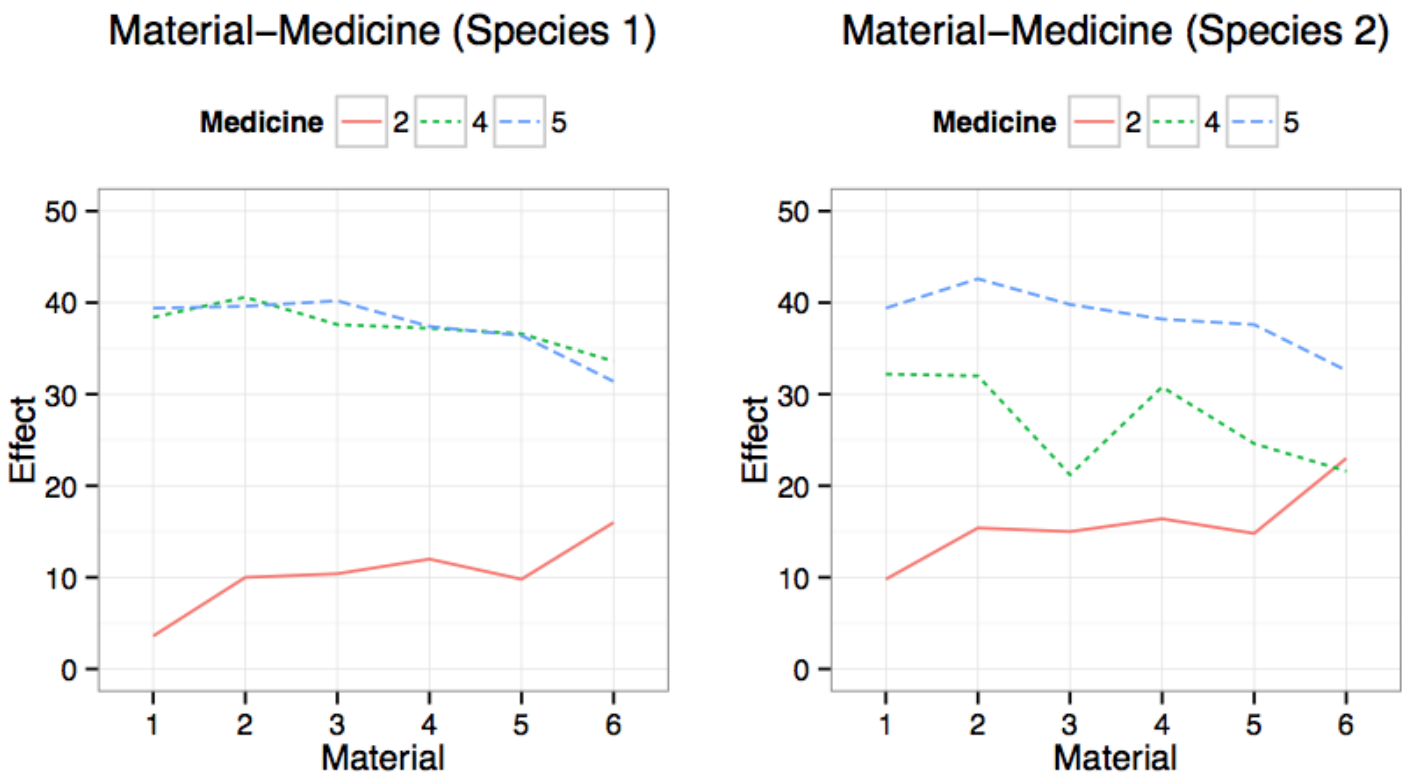
Sweave Example Code

```
202  In the ANOVA table above, there is evidence that the effect of the medicine-material
     interaction is different between the two species. Here are two plots visualizing
     this relationship:
203
204  \begin{figure}[H]
205  \caption{\textbf{Interaction Plots}}
206  <<intplot1, echo=FALSE, fig.height = 4>>=
207  # Plot second-order interaction for each species
208  species1clean <- species1 %>%
209    filter(!(Medicine %in% c(1,3)))
210
211  species2clean <- species2 %>%
212    filter(!(Medicine %in% c(1,3)))
213  intp1 <- ggplot(species1clean, aes(x=Material, y = Effect,
214                                     group = Medicine,
215                                     color = Medicine,
216                                     lty = Medicine)) +
217    stat_summary(fun.y = mean, geom = "line") +
218    ggtitle("Material-Medicine (Species 1)") +
219    ylim(0,50) + theme_bw() + theme(legend.position = "top")
```

Sweave Example Output

In the ANOVA table above, there is evidence that the effect of the medicine-material interaction is different between the two species. Here are two plots visualizing this relationship:

Interaction Plots



xtable/stargazer

Problem: R output is ugly.

Solution: `xtable/stargazer` creates Markdown/Latex code that is inserted into your document as-is.

xtable Example Code

```
188  \section*{Analysis}
189  Having prepared the data for analysis as described above, I fit a three-way ANOVA
     model with interactions. Here is the resulting ANOVA table:
190  <<anova1, echo=FALSE, results='asis'>>=
191  # Three-way ANOVA
192  infecmod <- lm(Effect~Medicine*Material*Species, data = infectedClean)
193  print(xtable(summary(aov(infecmod)),
194               caption = c("Three-way ANOVA")), table.placement = "H",
195        caption.placement = "top")
196  @
```

xtable Example Output

Three-way ANOVA

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Medicine	2	20373.03	10186.52	1580.67	0.0000
Material	5	291.80	58.36	9.06	0.0000
Species	1	74.76	74.76	11.60	0.0009
Medicine:Material	10	1686.17	168.62	26.16	0.0000
Medicine:Species	2	1963.14	981.57	152.31	0.0000
Material:Species	5	90.58	18.12	2.81	0.0187
Medicine:Material:Species	10	134.32	13.43	2.08	0.0293
Residuals	144	928.00	6.44		

stargazer Example Code

```
\section*{Appendix - Tables and Charts}
\label{effectstats}
<<effectstats, echo=FALSE, results='asis'>>=
# Summary statistics for response
stargazer(infected, keep = c(5), title = c("Summary of Effect Variable"),
          table.placement = "H")
@
```

stargazer Example Output

Appendix - Tables and Charts

Summary of Effect Variable

Statistic	N	Mean	St. Dev.	Min	Max
Effect	300	17.743	16.046	0	44

broom

Problem: A lot of common R objects have bizarre inner structure.

broom - Example: `lm`

```
Call:
lm(formula = mpg ~ wt + qsec, data = mtcars)

Residuals:
    Min      1Q  Median      3Q     Max
-4.3962 -2.1431 -0.2129  1.4915  5.7486

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  19.7462     5.2521   3.760 0.000765 ***
wt           -5.0480     0.4840 -10.430 2.52e-11 ***
qsec          0.9292     0.2650   3.506 0.001500 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.596 on 29 degrees of freedom
Multiple R-squared:  0.8264,    Adjusted R-squared:  0.8144
F-statistic: 69.03 on 2 and 29 DF,  p-value: 9.395e-12
```

broom - Example: `lm`

```
> str(mod2)
List of 12
 $ coefficients : Named num [1:3] 19.746 -5.048 0.929
  ..- attr(*, "names")= chr [1:3] "(Intercept)" "wt" "qsec"
 $ residuals    : Named num [1:32] -0.8151 -0.0482 -2.5273 -0.1806 0.5039 ...
  ..- attr(*, "names")= chr [1:32] "Mazda RX4" "Mazda RX4 Wag" "Datsun 710" "Hornet 4 Drive"
...
 $ effects      : Named num [1:32] -113.65 -29.116 -9.103 0.357 0.503 ...
  ..- attr(*, "names")= chr [1:32] "(Intercept)" "wt" "qsec" "" ...
 $ rank         : int 3
 $ fitted.values: Named num [1:32] 21.8 21 25.3 21.6 18.2 ...
  ..- attr(*, "names")= chr [1:32] "Mazda RX4" "Mazda RX4 Wag" "Datsun 710" "Hornet 4 Drive"
...
 $ assign       : int [1:3] 0 1 2
 $ qr           :List of 5
  ..$ qr   : num [1:32, 1:3] -5.657 0.177 0.177 0.177 0.177 ...
  .. ..- attr(*, "dimnames")=List of 2
  .. .. ..$ : chr [1:32] "Mazda RX4" "Mazda RX4 Wag" "Datsun 710" "Hornet 4 Drive" ...
  .. .. ..$ : chr [1:3] "(Intercept)" "wt" "qsec"
  .. ..- attr(*, "assign")= int [1:3] 0 1 2
```

broom - Example: `lm`

```
library(broom)
tidy(mod2)[,1:4]
```

```
##          term  estimate std.error  statistic
## 1 (Intercept) 19.746223 5.2520617   3.759709
## 2          wt -5.047982 0.4839974 -10.429771
## 3        qsec  0.929198 0.2650173   3.506179
```

broom - Supports

- `lm`, `glm`, `htest`, `anova`, `nls`, `kmeans`, `manova`
- `TukeyHSD`, `arima`, `lme4`, `glmnet`, `boot`, `gam`
- `survival`, `lfe`, `zoo`, `multcomp`, `sp`, `maps`, ...

Learning More