Purpose

This work was inspired by the following email from Farmer Ben.

From: Ben Chan
Sent: Thursday, June 11, 2015 4:04 PM
To: Stephanie Renfro
Subject: What to feed chicks

Hello,

I'm receiving 20 baby chicks next month. Can you help me decide what to feed them?

I'm choosing between the following four diets:

1. Grower diet
2. Layer diet
3. Breeder diet
4. High cluckage diet

Thanks,
Ben
Preliminaries

Start clock to calculate total runtime.

```r
start_program <- proc.time()
```

Load needed packages:

- `data.table` - for faster processing
- `knitr` - for better table display (“kable” function)
- `ggplot2` - for pretty plots

```r
packages <- c("data.table", "knitr", "ggplot2")
sapply(packages, require, character.only=TRUE, quietly=TRUE)
```

```r
## data.table knitr ggplot2
## TRUE      TRUE      TRUE
```

Define the CHSE color palette function.

```r
colorPalette <- function () {
c(rgb( 1, 67, 134, maxColorValue=255),
   rgb(119, 120, 123, maxColorValue=255),
   rgb(139, 184, 234, maxColorValue=255),
   rgb(188, 190, 192, maxColorValue=255),
   rgb( 94, 122, 162, maxColorValue=255),
   rgb(223, 122, 28, maxColorValue=255))
}
```

Prepare Data

This demo uses data from an experiment on the effect of diet on early growth of chicks, `ChickWeight`, which comes pre-loaded in any R session.

Let’s take a look at the first few rows:

```r
head(ChickWeight)
```

```r
## weight Time Chick Diet
## 1  42   0   1  1
## 2  51   2   1  1
## 3  59   4   1  1
## 4  64   6   1  1
## 5  76   8   1  1
## 6  93  10   1  1
```

Let’s also print a summary of the data.

*Note, by specifying the option “echo = FALSE”, the resulting output will display, but not the code that generated it.*
## weight Time Chick Diet
## Min. :35.0 Min. :0.00  13 :12  1:220
## 1st Qu.:63.0 1st Qu.:4.00  9 :12  2:120
## Median :103.0 Median:10.00 20 :12  3:120
## Mean :121.8  Mean:10.72 10 :12  4:118
## 3rd Qu.:163.8 3rd Qu.:16.00 17 :12
## Max. :373.0 Max.:21.00 19 :12
## (Other):506

Convert to data.table for faster processing.

ChickWeight <- data.table(ChickWeight)

Create a table showing mean weight at times 0, 10, and 21 days, for each of the four diet types.

mean_ChickWeight <- ChickWeight[Time %in% c(0,10,21),
                              list(mean_weight = round(mean(weight), digits=1)),
                              by = list(Diet,Time)]

kable(mean_ChickWeight)

<table>
<thead>
<tr>
<th>Diet</th>
<th>Time</th>
<th>mean_weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>41.4</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>93.1</td>
</tr>
<tr>
<td>1</td>
<td>21</td>
<td>177.8</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>40.7</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>108.5</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>214.7</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>40.8</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>117.1</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>270.3</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>41.0</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>126.0</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>238.6</td>
</tr>
</tbody>
</table>

Create a character variable for diet. Use this variable for plotting small multiples.

ChickWeight[, dietChr := sprintf("Diet %d", Diet)]

## weight Time Chick Diet dietChr
## 1:  42 0 1 1 Diet 1
## 1:  51 2 1 1 Diet 1
## 1:  59 4 1 1 Diet 1
## 1:  64 6 1 1 Diet 1
## 1:  76 8 1 1 Diet 1
## ---
## 574: 175 14 50 4 Diet 4
## 575: 205 16 50 4 Diet 4
## 576: 234 18 50 4 Diet 4
## 577: 264 20 50 4 Diet 4
## 578: 264 21 50 4 Diet 4
Growth for Individual Chicks

The following plot illustrates the growth curve for individual chicks from 0 to 21 days. Colors represent the four diets.

```r
ggplot() + 
  geom_line(data=ChickWeight, aes(x=Time, y=weight, color=dietChr, group=Chick)) + 
  scale_color_manual(values=colorPalette()) + 
  ggtitle("Growth Curve for Individual Chicks")
```

From this plot, it is difficult to distinguish between the performance of the four diets.
Individual growth curves

Plot individual chick growth curves using small multiples.

```r
ggplot() +
  geom_line(data=ChickWeight, aes(x=Time, y=weight, color=dietChr, group=Chick)) +
  facet_wrap(~ dietChr, nrow=1) +
  scale_color_manual(values=colorPalette()) +
  theme(legend.position="none") +
  ggtitle(bquote(atop("Growth Curve for Individual Chicks")))
```
**Fitted growth curves**

Plot fitted growth curves using small multiples. Data points are jittered around time value.

```r
ggplot() + geom_jitter(data=ChickWeight, aes(x=Time, y=weight, colour=dietChr)) + geom_smooth(data=ChickWeight, aes(x=Time, y=weight, colour=dietChr)) + facet_wrap(~ dietChr, nrow=1) + scale_color_manual(values=colorPalette()) + theme(legend.position="none") + ggtitle(bquote(atop("Fitted Growth Curves")))
```

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**Fitted Growth Curves**

![Fitted Growth Curves](image-url)
Final weight density

Plot densities by diet for chicks' final weights (day 21) using small multiples.

```r
ggplot(ChickWeight[Time==21], aes(x=weight, colour=dietChr, fill=dietChr)) +
  geom_density() +
  facet_wrap(~ dietChr, nrow=4) +
  scale_color_manual(values=colorPalette()) +
  scale_fill_manual(values=colorPalette()) +
  theme(legend.position="none") +
  ggtitle(bquote(atop("Density: Final Weight")))
```

![Density: Final Weight](image)

Wrap Up

Calculate total runtime and clear memory.

```r
time_program <- proc.time()-start_program
print(paste("Total runtime: ", format(time_program[3]/60,digits=3), " minutes"))
```

```r
## [1] "Total runtime: 0.0805 minutes"
```

```r
rm(list=ls())
invisible(gc())
```