Figures using ggplot2

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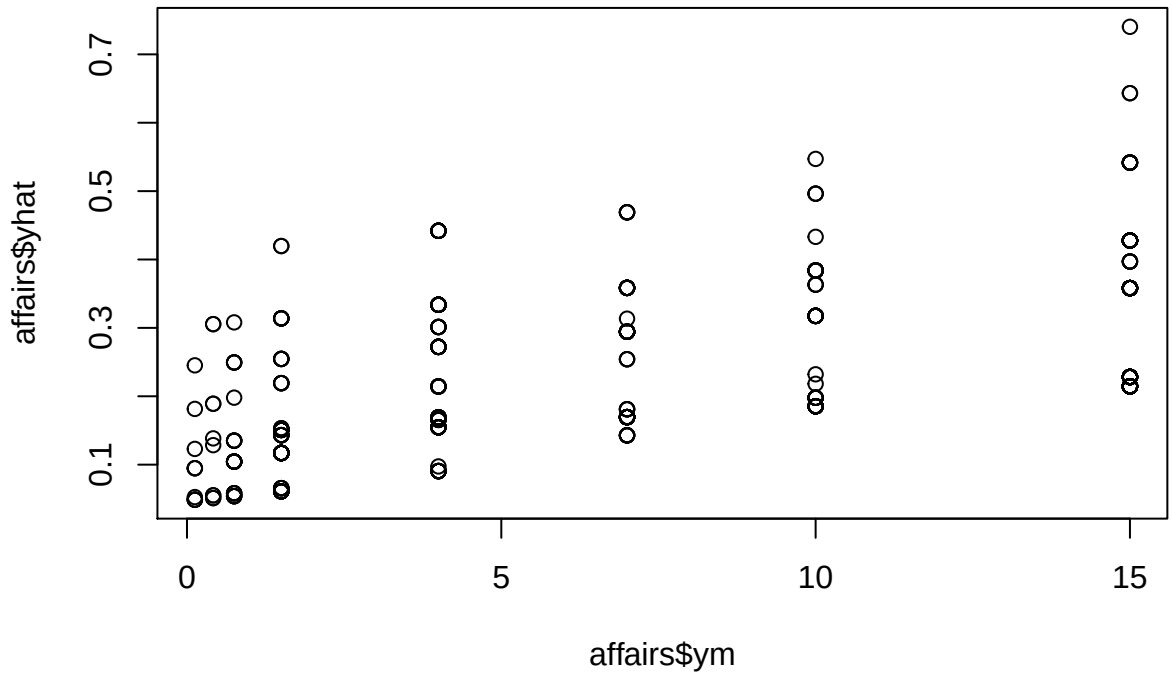
The graphical toolbox in R is particularly impressive. I very much like the default plotting library that ships with R: it is clear, simple, and you can build pretty much any figure you can imagine, because it allows to add and manipulate every single element of the figure.

Let's take the model we built before with some minor changes:

```
affairs <- read.csv("http://koaning.io/theme/data/affairs.csv")
affairs$R <- affairs$nbaffairs > 0
sample_model <- glm(R ~ ym*child + factor(religious),
                    data=affairs,
                    family=binomial)
```

and create an easy plot of the predictions:

```
affairs$yhat <- predict(sample_model, newdata=affairs, type="response")
plot(affairs$ym, affairs$yhat)
```



and with some effort we could customize the picture a bit:

```
plot(affairs$ym, affairs$yhat,
     col="red",
```

```
     pch=19,
     bty="n",
     main="", xlab="", ylab="",
     panel.first=grid())
title(xlab="Years of marriage",
      ylab="Predicted probability of affair",
      main="Partial effect of years of marriage")
abline(lm(affairs$yhat ~ affairs$ym),
       lty=2,
       col="gray20")
legend(9.5, 0, "Best fit", col="gray20", lty=2, bty="n")
```

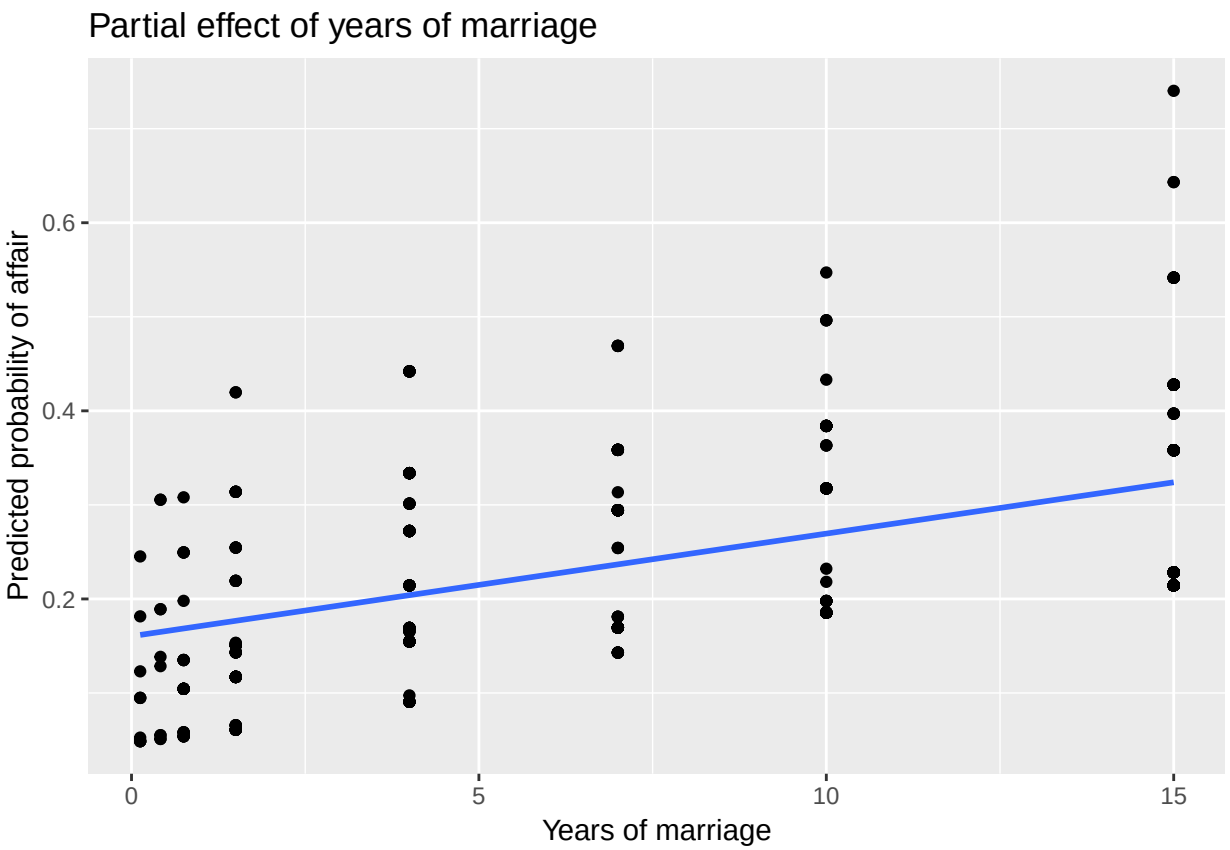
However, its flexibility comes at a cost, and figures usually require a lot of work.

The `ggplot2`, which implements the "grammar of graphics" approach to building data visualization, has rightfully gained a great deal of popularity, and it is the library that we will use here.

```
install.packages("ggplot2")
library(ggplot2)
```

Before going into details, let's start

```
p <- ggplot(affairs, aes(x=ym, y=yhat))
p + geom_point() +
  labs(title="Partial effect of years of marriage",
       x="Years of marriage",
       y="Predicted probability of affair") +
  geom_smooth(method="lm", se=FALSE)
```

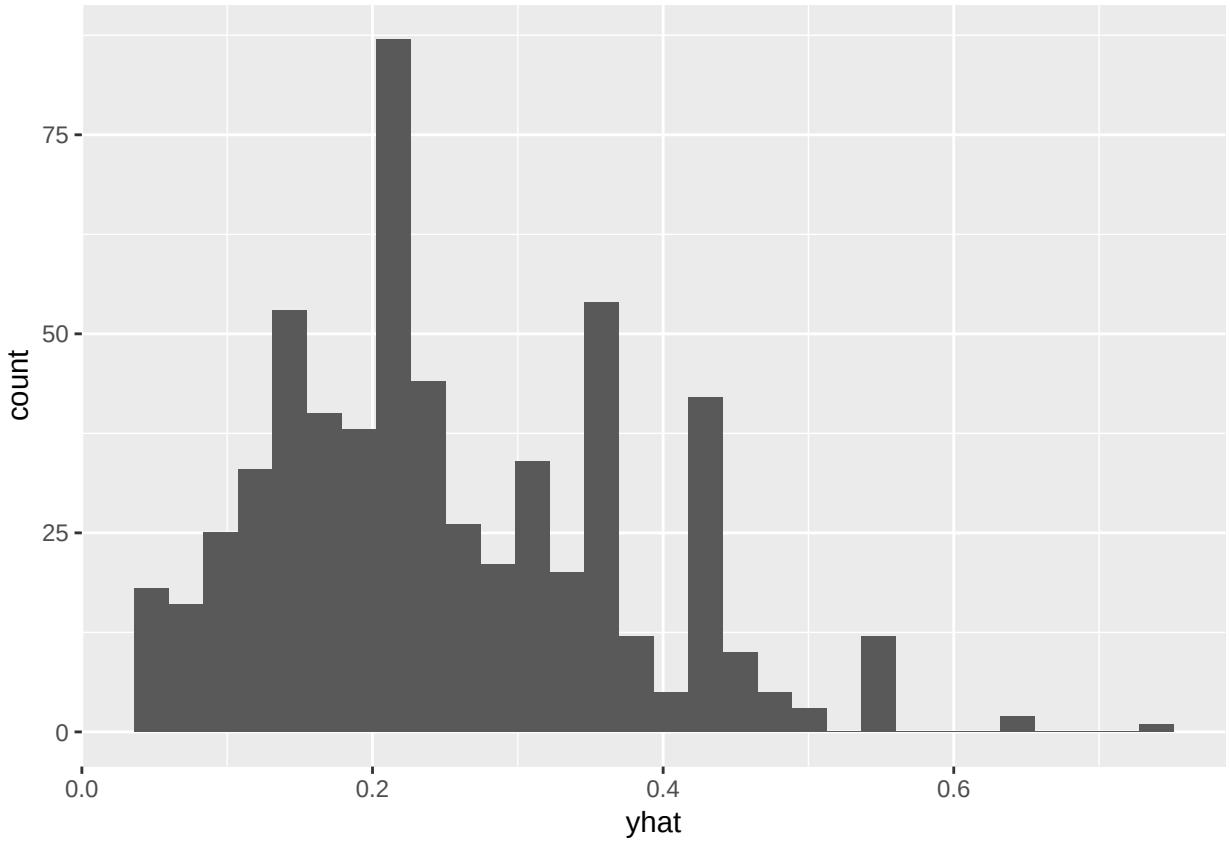


The advantages of `ggplot2` as, I hope, can be seen above are that 1) it is much easier to create a publication-ready figure and 2) the syntax is also cleaner. If nothing else, `ggplot2` offers "sensible" defaults for plots but in exchange the approach to building plots is slightly different from other languages —although it is currently adopted in many other tools.

The structure of a figure in `ggplot2` is simple. We first define the data.frame that we will be using, the basic aesthetics for the figure (which variables go to which axis, whether the the dataset is grouped). We use the `ggplot` function for that. Then, we add the different layers of the figure that correspond to the different elements of ghe graph.

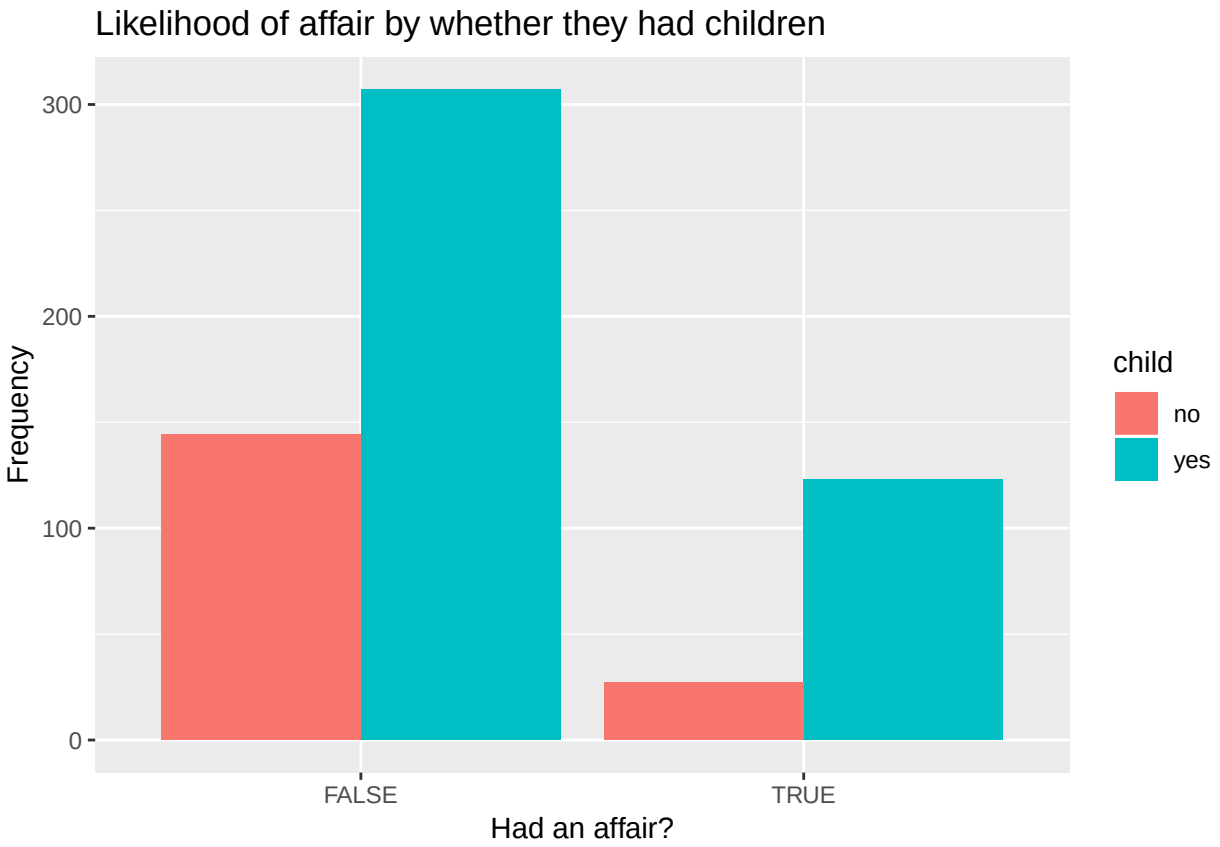
For instance, to define a histogram to plot the distribution of our predicted variable, all we need is one variable living in a dataset:

```
p <- ggplot(affairs, aes(x=yhat))
p + geom_histogram()
```



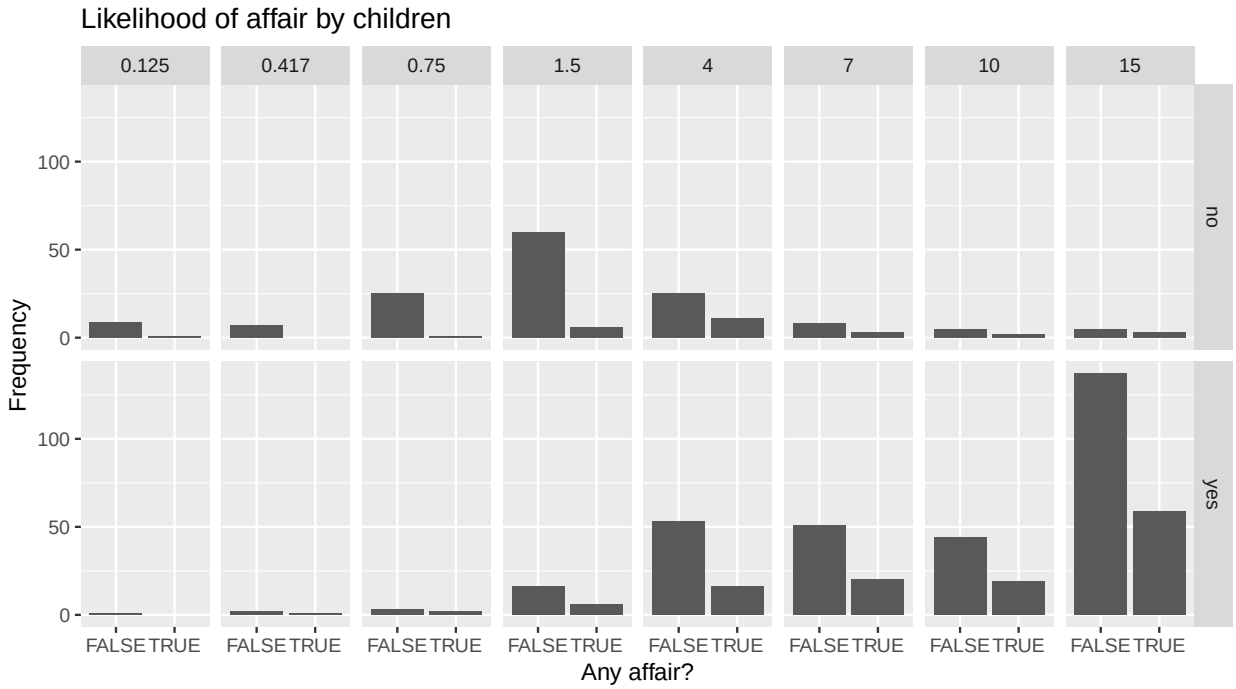
Getting the distribution of the predicted probability by whether the man has kids is easy: we declare that data is grouped by `child` and, in addition, that the bar corresponding to each of the values of `child` will have a different color. In addition, we add labels and a title (because we love good practices):

```
p <- ggplot(affairs, aes(x=nbaffairs > 0, group=child, fill=child))
p + geom_bar(position="dodge") +
    labs(title="Likelihood of affair by whether they had children",
         x="Had an affair?", y="Frequency")
```



`ggplot2` that makes it very easy to get conditional plots. For instance, our theoretical model above posed an interaction between years of marriage and whether the man had children. This is, the expected number of affairs for a given time ellapsed in marriage is expected to be different depending on whether the man has children or not. Therefore, in the exploration of our data, we would like to see the number of affairs by `ym` and by `children`. For instance, we could look at:

```
p <- ggplot(affairs, aes(x=nbaffairs > 0, group=child))
p + geom_bar(position="dodge") +
    facet_grid(child ~ ym) +
    labs(title="Likelihood of affair by children", x="Any affair?", y="Frequency")
```



What we see in the representation above is a number of `facets`. The upper section represents the distribution for the cases in which the man didn't have children. The bottom section, the cases for which he did. In each of the vertical cells we see different durations of marriage. We see that men without children seem more likely have affairs right after being married but then the difference between the `yes` and `no` bars decrease over time after reaching a peak in around 1.5 years of marriage. However, for men *with* children, the difference grows over time.

We can now compare this result to what we estimated in the model above. To do that, we will repeat the same process we did before. First we create a fake data frame that captures the effect we are interested in, and then we apply our model to the data:

```
fake_data <- expand.grid(ym=sort(unique(affairs$ym)),
                         child=c("no", "yes"),
                         religious=1)

fake_data$phat <- predict(sample_model, newdata=fake_data, type="response")
fake_data
```

```
##        ym child religious      phat
## 1   0.125    no         1 0.1814869
## 2   0.417    no         1 0.1890527
## 3   0.750    no         1 0.1979732
## 4   1.500    no         1 0.2192134
## 5   4.000    no         1 0.3013084
## 6   7.000    no         1 0.4192001
## 7  10.000    no         1 0.5470998
## 8  15.000    no         1 0.7402603
## 9   0.125   yes         1 0.4075765
## 10  0.417   yes         1 0.4101427
## 11  0.750   yes         1 0.4130751
## 12  1.500   yes         1 0.4197021
## 13  4.000   yes         1 0.4419892
```

```
## 14  7.000   yes          1 0.4690376
## 15 10.000   yes          1 0.4962690
## 16 15.000   yes          1 0.5416242
```

First some housekeeping:

```
library(scales)
levels(fake_data$child) <- c("No", "Yes")
cols <- colorspace:::rainbow_hcl(2)
print(cols)
```

```
## [1] "#E495A5" "#39BEB1"
```

And now we plot things with some additional details to make it look ready for a presentation:

```
p <- ggplot(fake_data, aes(x=ym, y=phat, colour=child))
pq <- p + geom_line() +
    geom_rug() +
    facet_wrap( ~ child) +
    labs(title="Predicted values of the main model",
         x="Years of marriage",
         y="Probability of affair") +
    scale_color_manual("Have\nchildren?",
                       values=c("No"=cols[1],
                                "Yes"=cols[2]))
print(pq)
```

How to save a figure? The easiest way is probably to use the `ggsave` wrapper:

```r
ggsave("my-pretty-figure.png", pq)
```