Day 4 : Data Visualization Fundamentals in R

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Visualizations

The ggplot2 library is an extremely popular visualization package that provides an interface for extremely fine control over graphics for plotting.

Install ggplot2 and viridis

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

```
library(ggplot2)
```

```
install.packages("viridis")
```

```
library(viridis)
```

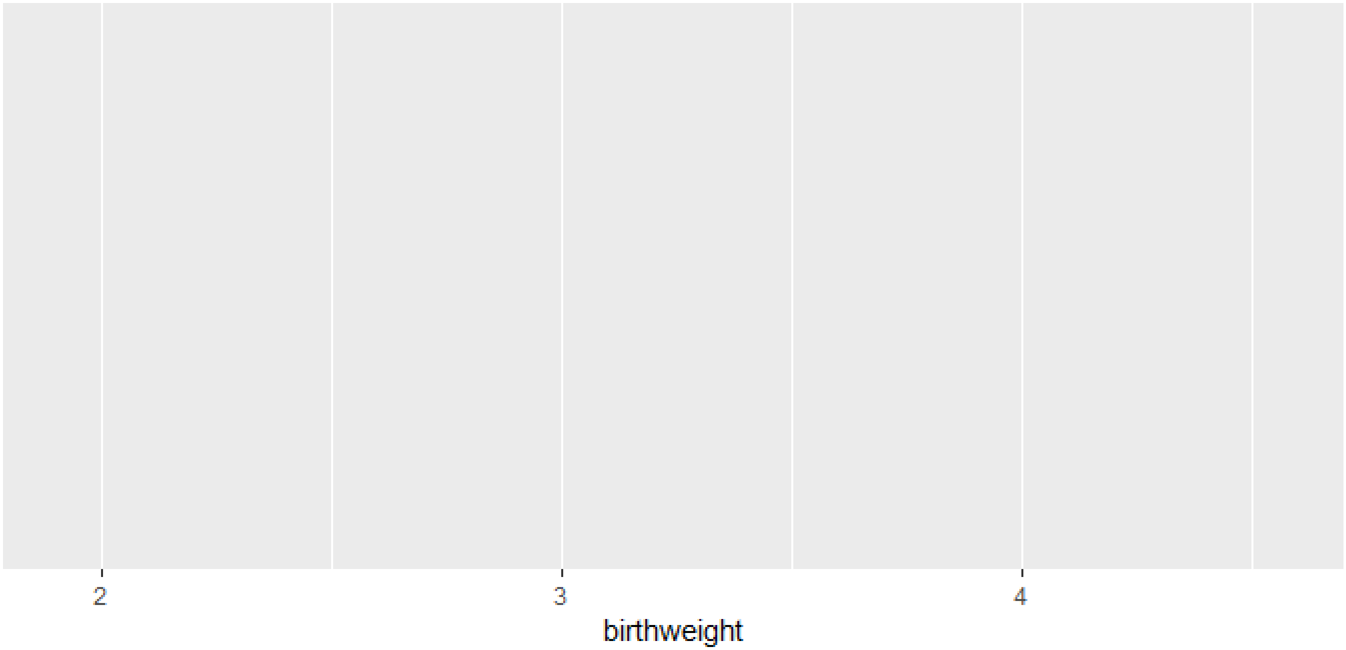
Viridis is Colorblind-Friendly Color Maps for R

ggplot2

```
?ggplot
```

```
ggplot(data = birthdata, mapping = aes(x = birthweight))
```

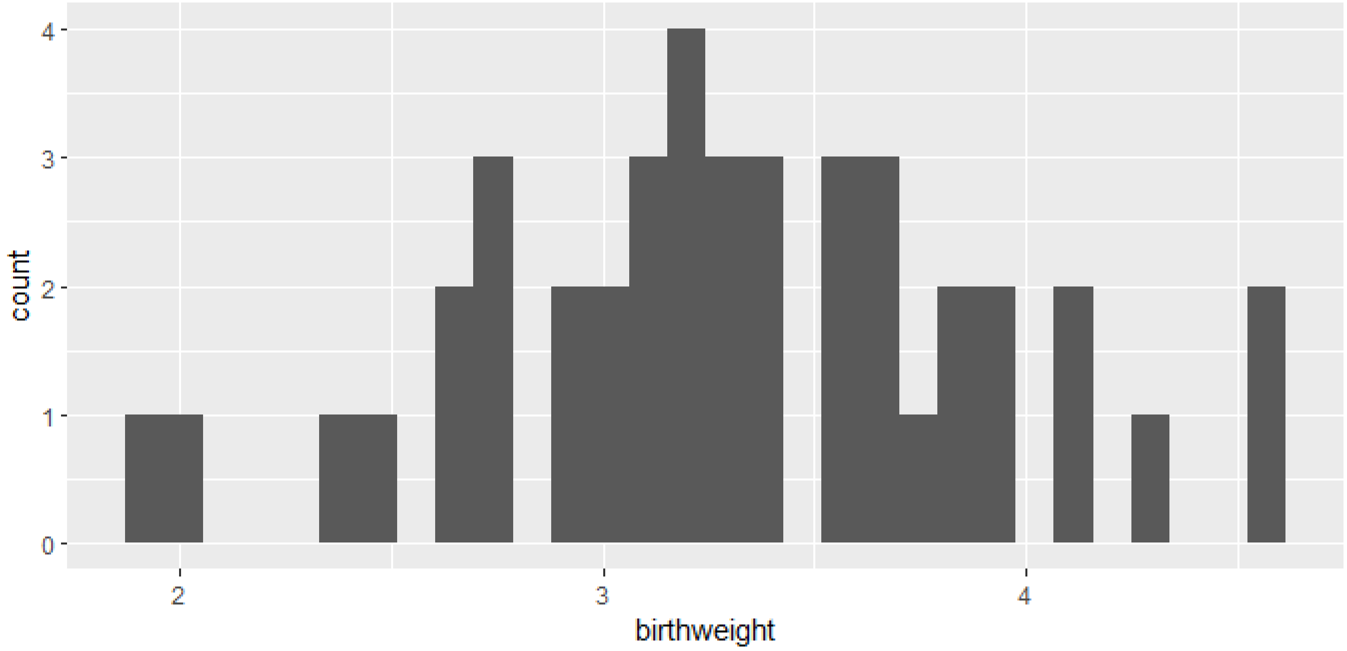
This outputs a blank canvas.



geom

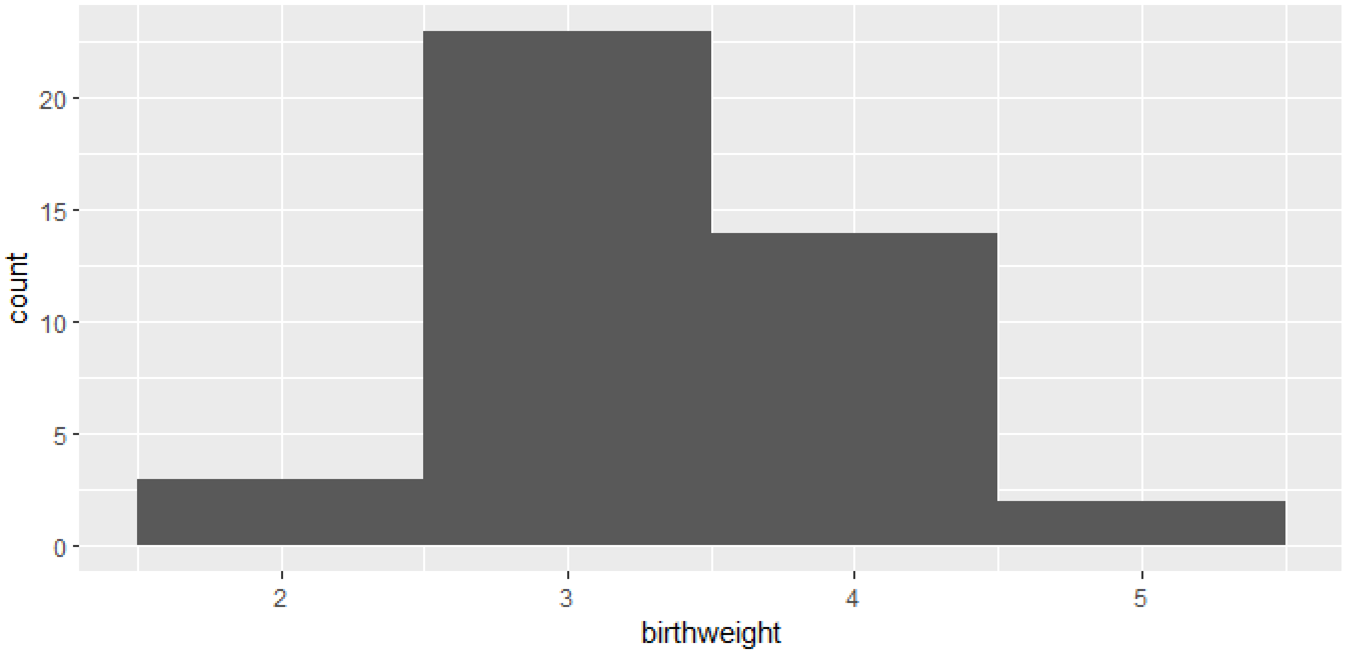
There are 30 geoms in the ggplot2 library, lets start with histogram.

```
ggplot(data = birthdata, mapping = aes(x = birthweight)) + geom_histogram()
```

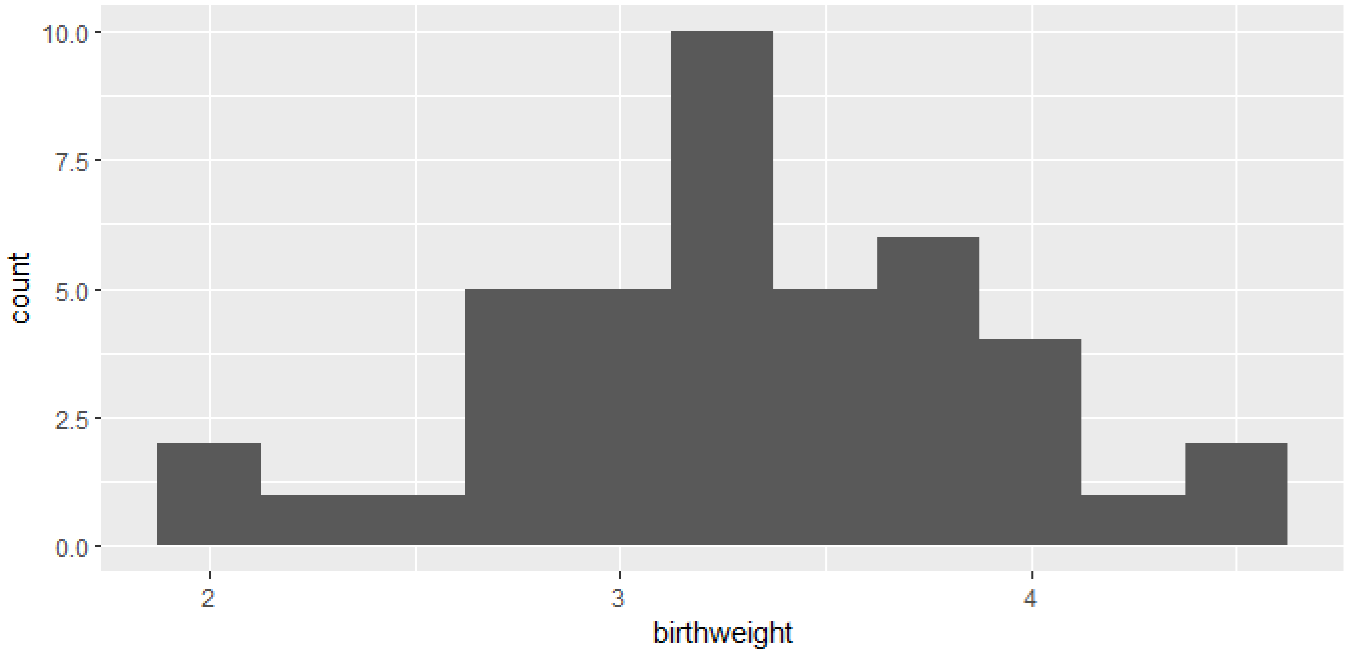


But we get a warning : `stat_bin()` *using* `bins = 30`*. Pick better value with* `binwidth`\`

```
ggplot(data = birthdata, mapping = aes(x = birthweight)) +
geom_histogram(binwidth = 1)
```

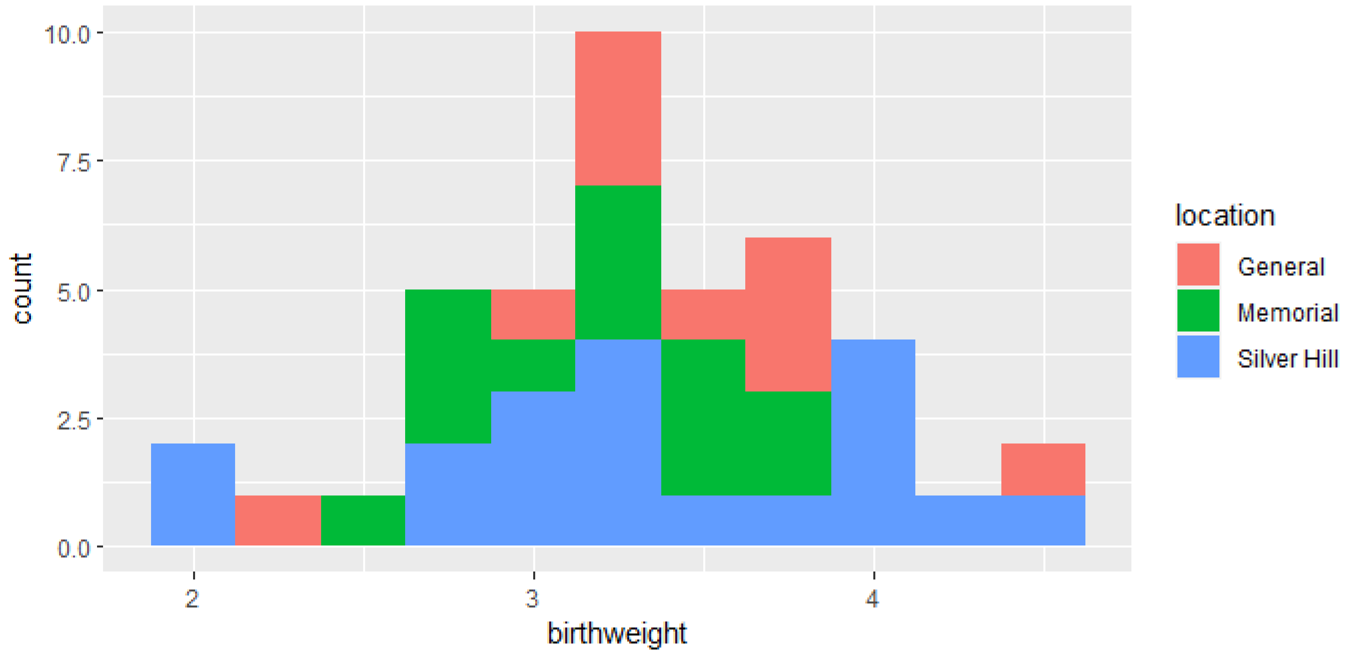


```
ggplot(data = birthdata, mapping = aes(x = birthweight)) +
geom_histogram(binwidth = 0.25)
```



Adding color (and fill) to geoms

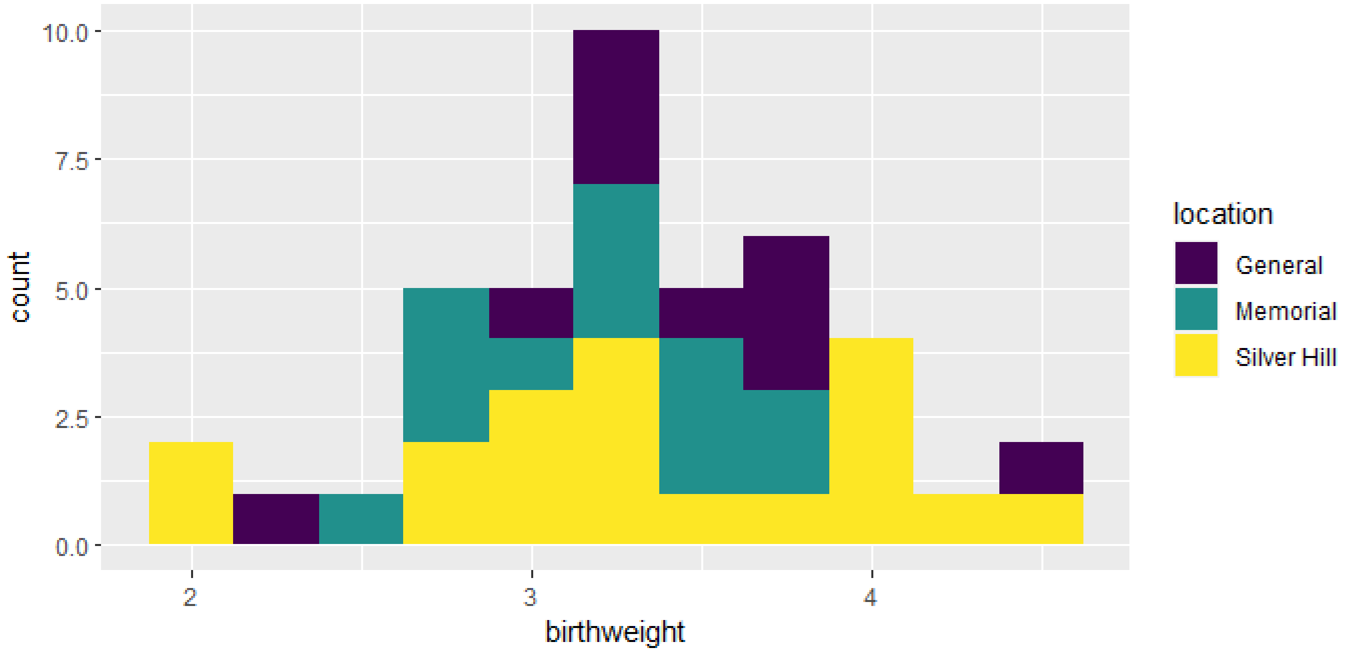
```
ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
geom_histogram(binwidth = 0.25)
```



Making it colorblind friendly palette

```
locations.palette <- viridis(3)
```

```
ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
geom_histogram(binwidth = 0.25) + scale_fill_manual(values = locations.palette)
```



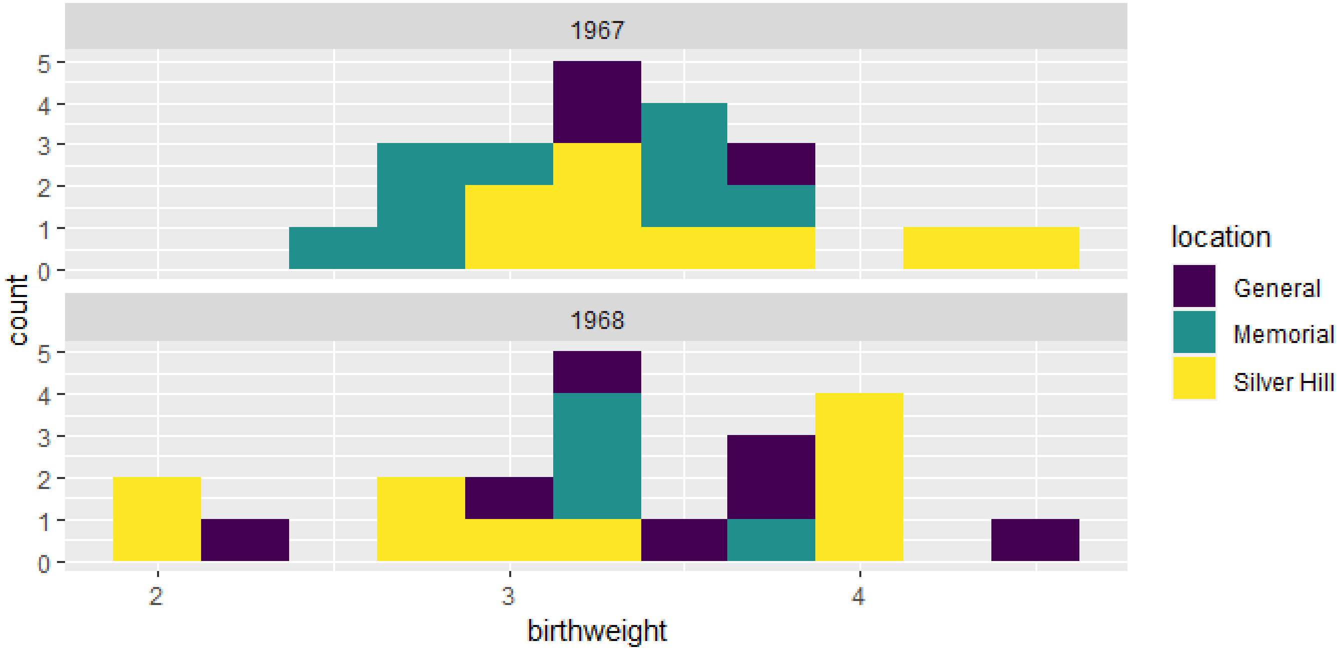
Creating faceted plots

Create multiple sub-plots or “facets” based on categorical values in the data.

The facet_wrap() and facet_grid() functions allow the user to break the data down into multiple plots by one or two categorical variables, respectively.

```
ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
geom_histogram(binwidth = 0.25) + scale_fill_manual(values = locations.palette) +
facet_wrap(~year, nrow = 2)
```

We used facet_wrap to year and grid rows as 2.



Add and modify labels

The labs() function offers the option to set the following labels:

- any aesthetic that has been set: in this case, x and fill
- title: main title of the plot
- subtitle: displayed below the title
- caption: displayed at the bottom right of the plot by default
- tag: label that appears at the top left of the plot by default (e.g. 1A)
- alt, alt_insight: alt text for the plot (used by screen readers)

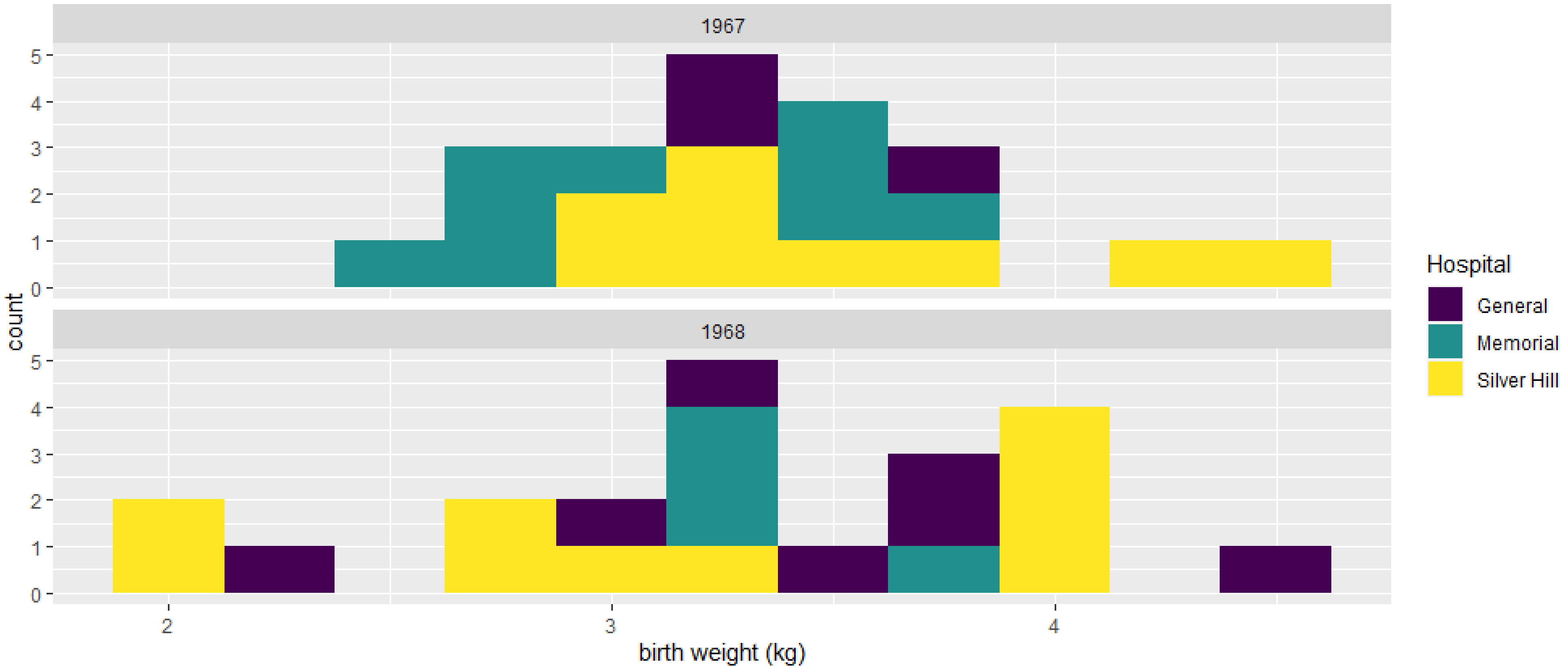
Add and modify labels

```
ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
geom_histogram(binwidth = 0.25) + scale_fill_manual(values = locations.palette) +
facet_wrap(~year, nrow = 2) + labs(x = "birth weight (kg)", fill = "Hospital",
tag = "fig. 1", caption = "Birth weights by year, color-coded by delivery
location.", alt = "Pair of histograms displaying the distribution of birth
weights of infants born at General Hospital, Memorial Hospital, and Silver Hill
Medical Center in 1967 and 1968.")
```

Breaking down the command

- ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
- geom_histogram(binwidth = 0.25) +
- scale_fill_manual(values = locations.palette) +
- facet_wrap(~year, nrow = 2) +
- labs(x = "birth weight (kg)",
    - fill = "Hospital",
    - tag = "fig. 1",
    - caption = "Birth weights by year, color-coded by delivery location.",
    - alt = "Pair of histograms displaying the distribution of birth weights of infants born at General Hospital, Memorial Hospital, and Silver Hill Medical Center in 1967 and 1968.")

fig. 1

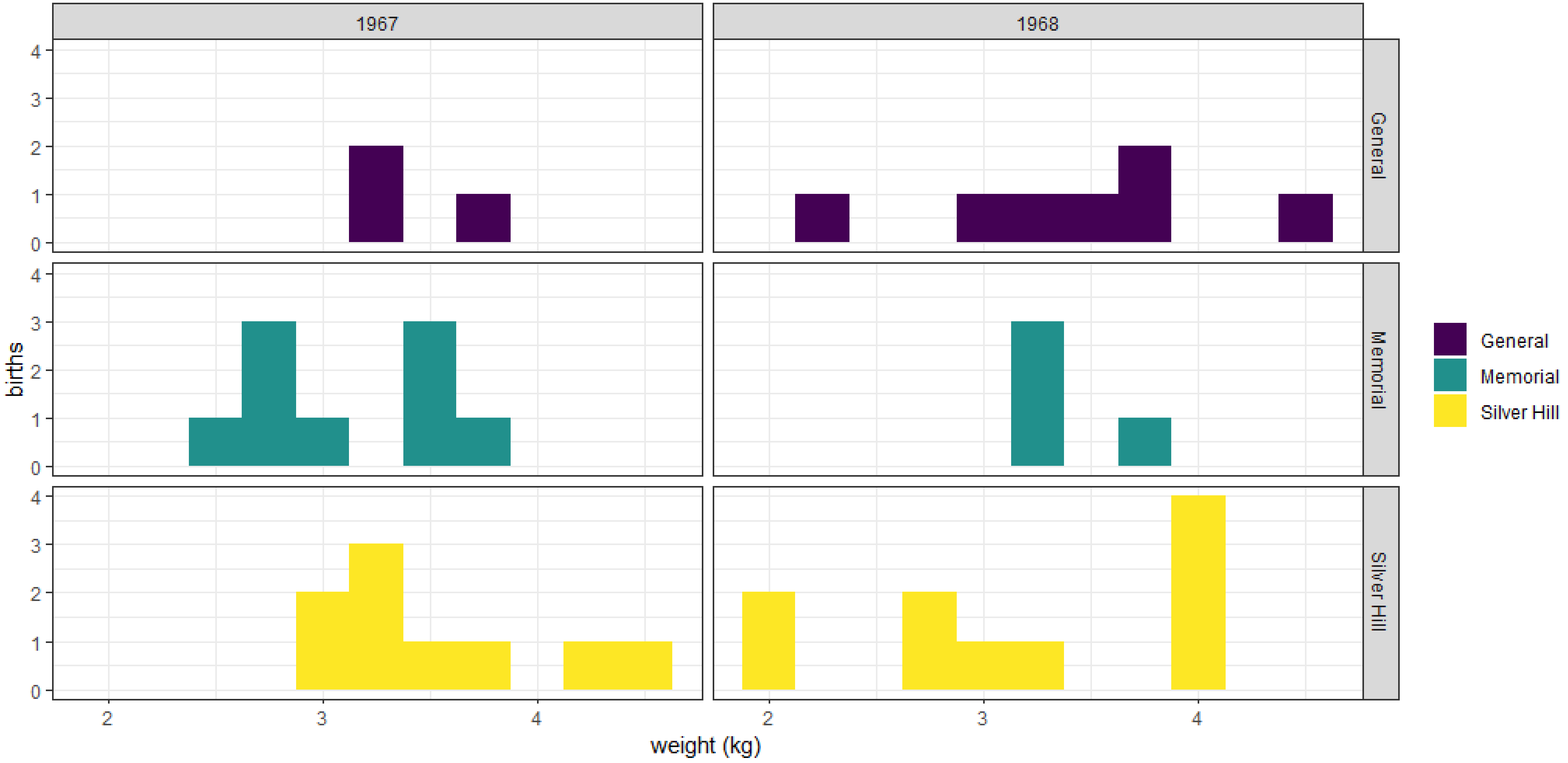


Birth weights by year, color-coded by delivery location.

Plot Themes

```
ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
geom_histogram(binwidth = 0.25) + scale_fill_manual(values = locations.palette) +
facet_grid(location~year) + labs(x = "weight (kg)", y = "births") + theme_bw() +
theme(legend.title = element_blank())
```

- ggplot(data = birthdata, mapping = aes(x = birthweight, fill = location)) +
- geom_histogram(binwidth = 0.25) +
- scale_fill_manual(values = locations.palette) +
- facet_grid(location~year) +
- labs(x = "weight (kg)", y = "births") +
- theme_bw() +
- theme(legend.title = element_blank())


1967
1968
General
Memorial
Silver Hill
births
0
1
2
3
4
2
3
4
weight (kg)
General
Memorial
Silver Hill

geom_density()

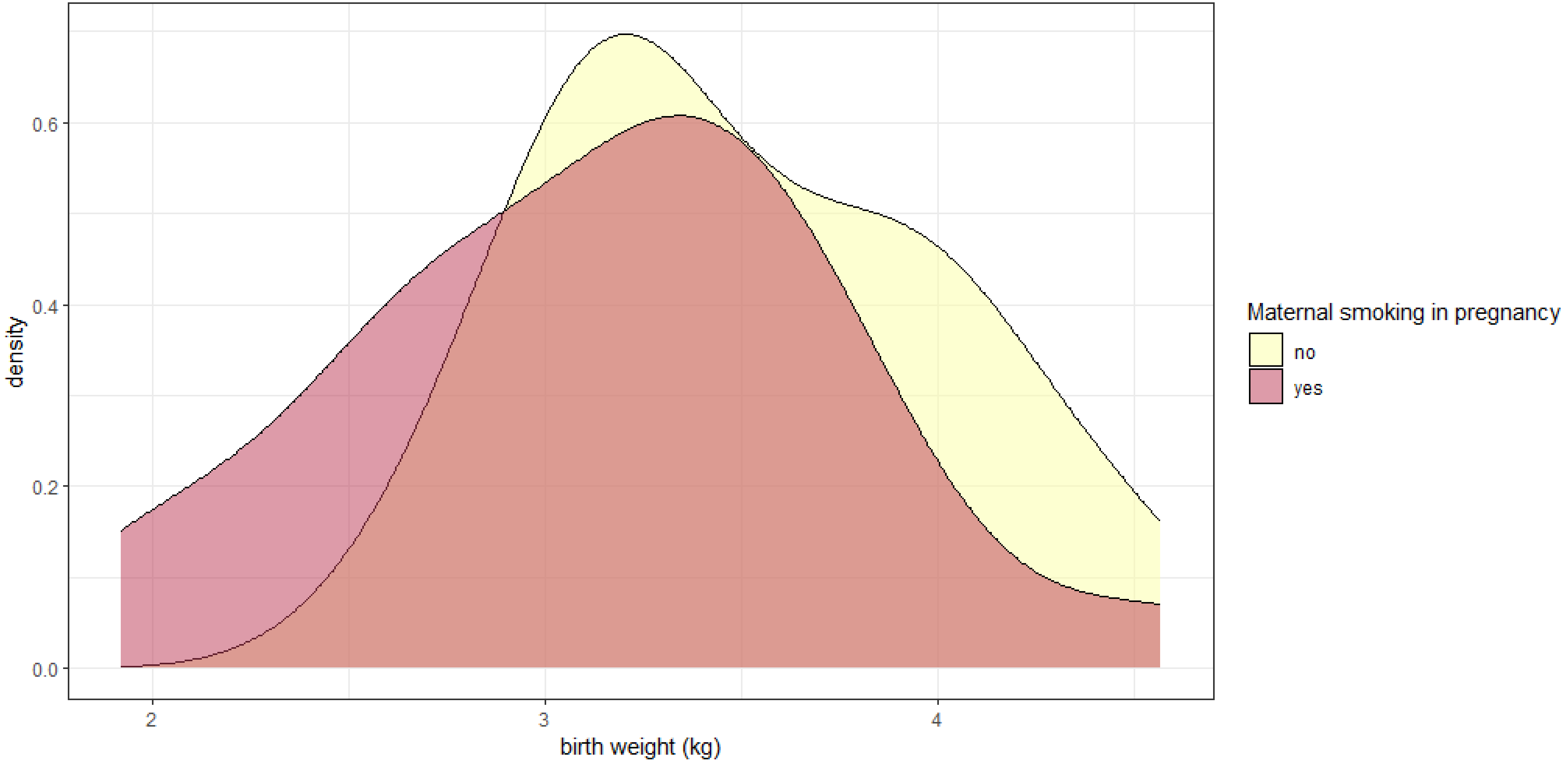
lets create a new color blind palette

```
smoking.palette <- inferno(2, begin = 0.5, direction = -1)
```

`?inferno` to learn more bout this.

```
ggplot(data = birthdata, mapping = aes(x = birthweight, fill = smoker)) +
geom_density(alpha = 0.5) + scale_fill_manual(values = smoking.palette) + labs(x
= "birth weight (kg)", fill = "Maternal smoking in pregnancy") + theme_bw()
```

geom_density() plot



geom_point()

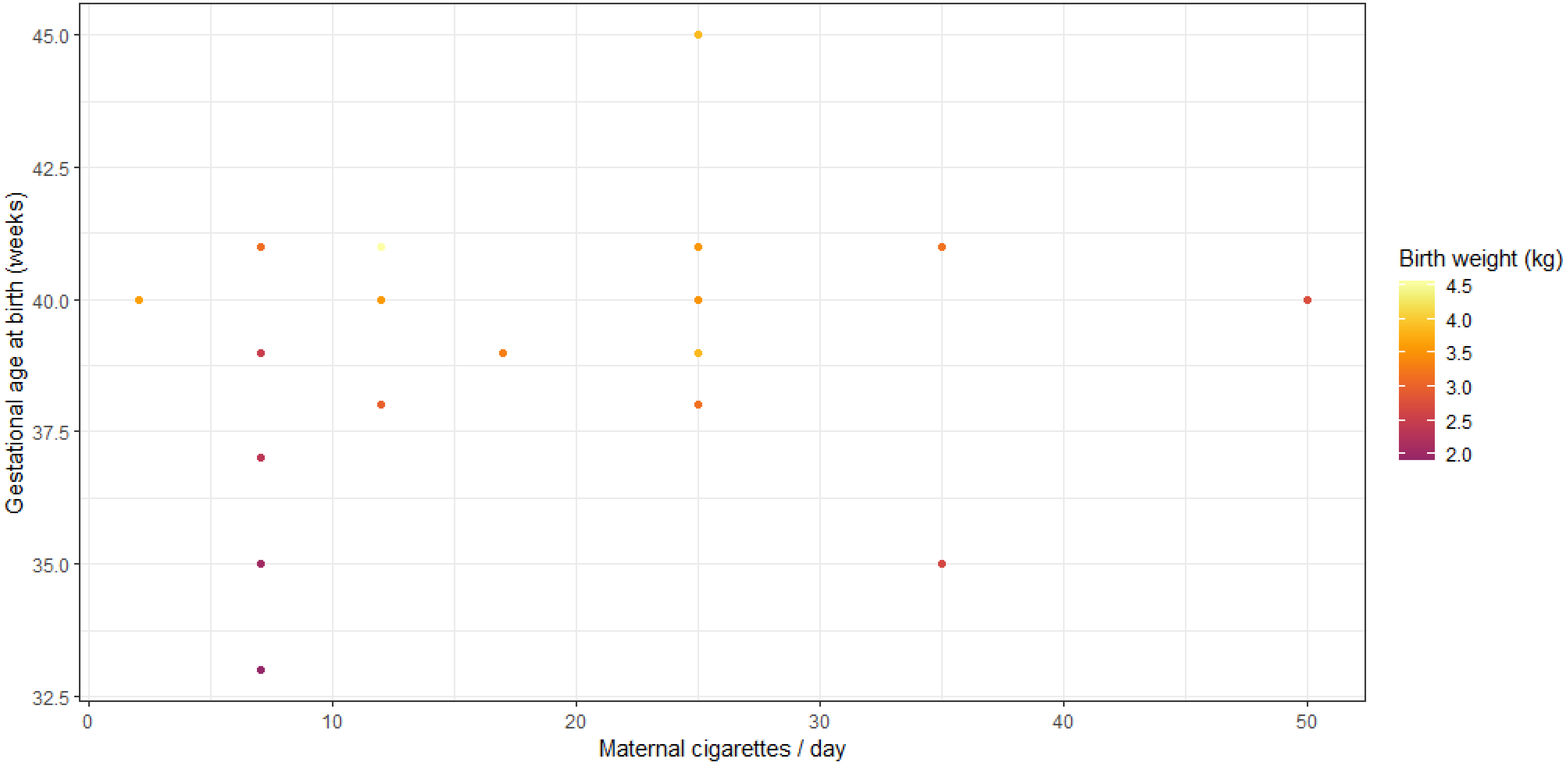
Filter out smokers from birthdata

```
filtered_data <- birthdata[birthdata$smoker == TRUE, ]
```

Plot using geom point

```
ggplot(data = filtered_birthdata, mapping = aes(x = maternal.cigarettes, y =
weeks.gestation, color = birthweight)) + geom_point()  + labs(x = "Maternal
cigarettes / day", y = "Gestational age at birth (weeks)", color = "Birth weight
(kg)") + scale_color_viridis(option = "inferno", begin = 0.4) + theme_bw()
```

geom_point() plot



No need to specify a color palette; viridis has a built-in function for ggplot objects.

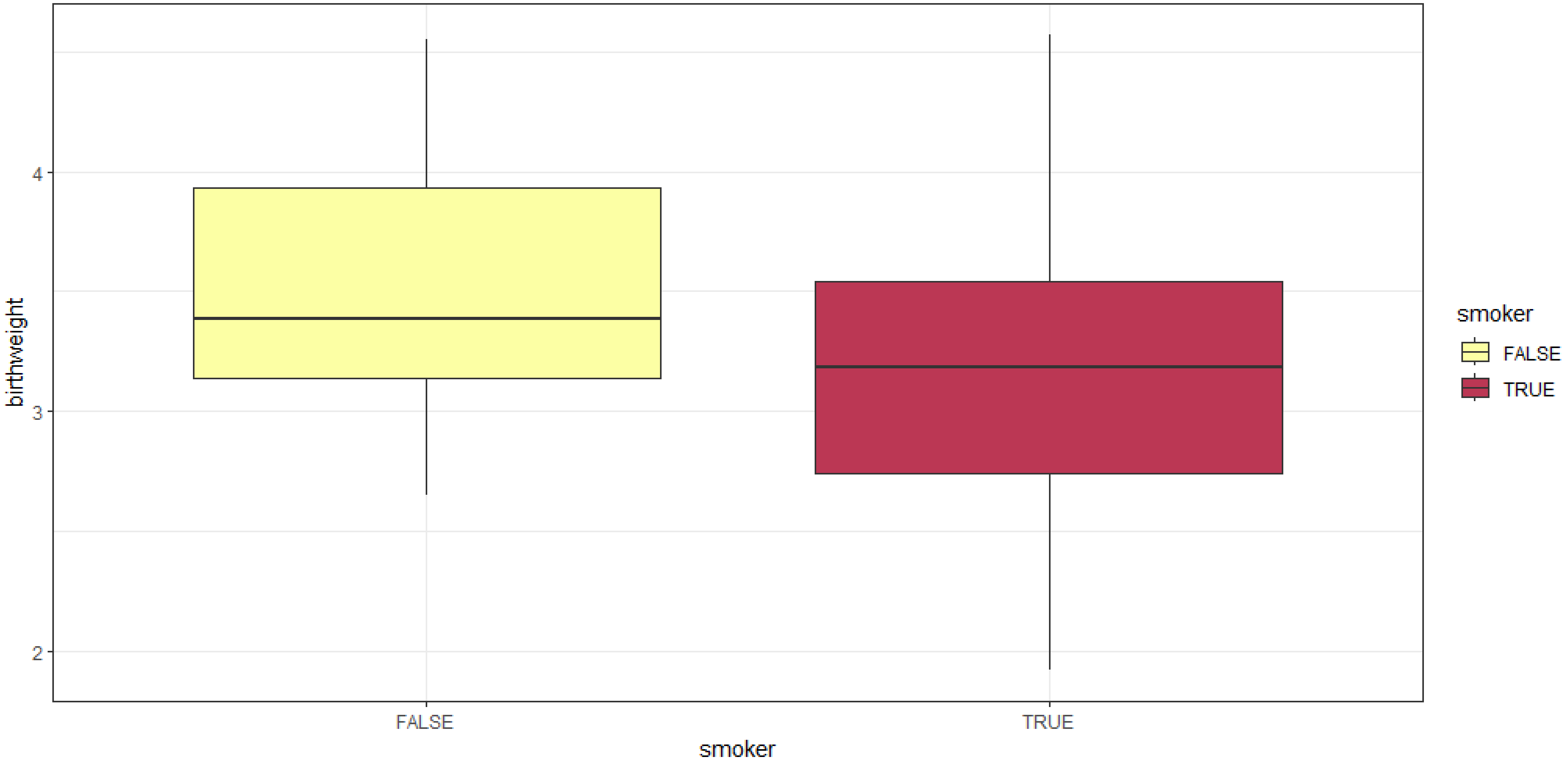
geom_boxplot()

```
ggplot(data = birthdata, mapping = aes(x = smoker, y = birthweight, fill = smoker)) + geom_boxplot() + scale_fill_manual(values = smoking.palette) + theme_bw()
```

The labels on a categorical axis should be meaningful.

The bar chart above displays the values “TRUE” and “FALSE” on the x-axis.

geom_boxplot() plot



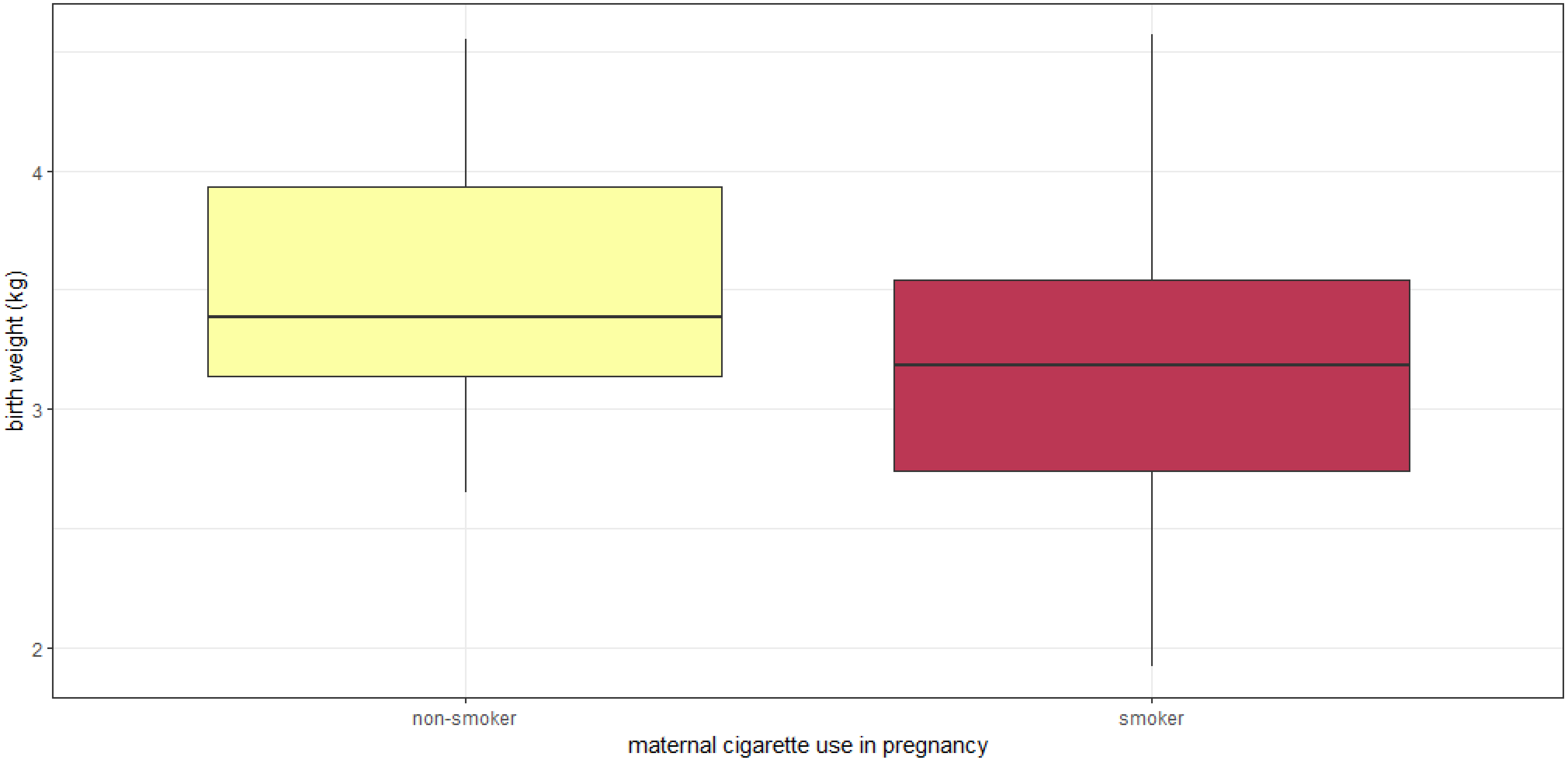
geom_boxplot() for Publications

In a report or publication, it might be more informative to replace “TRUE” and “FALSE” with “smoker” and “non-smoker.”

The scale_x_discrete() function is used to do that.

```
ggplot(data = birthdata, mapping = aes(x = smoker, y = birthweight, fill =
smoker)) + geom_boxplot() + scale_fill_manual(values = smoking.palette) +
scale_x_discrete(labels = c("non-smoker", "smoker")) + guides(fill = "none") +
labs(y = "birth weight (kg)", x = "maternal cigarette use in pregnancy") +
theme_bw()
```

geom_boxplot() for Publications Plot



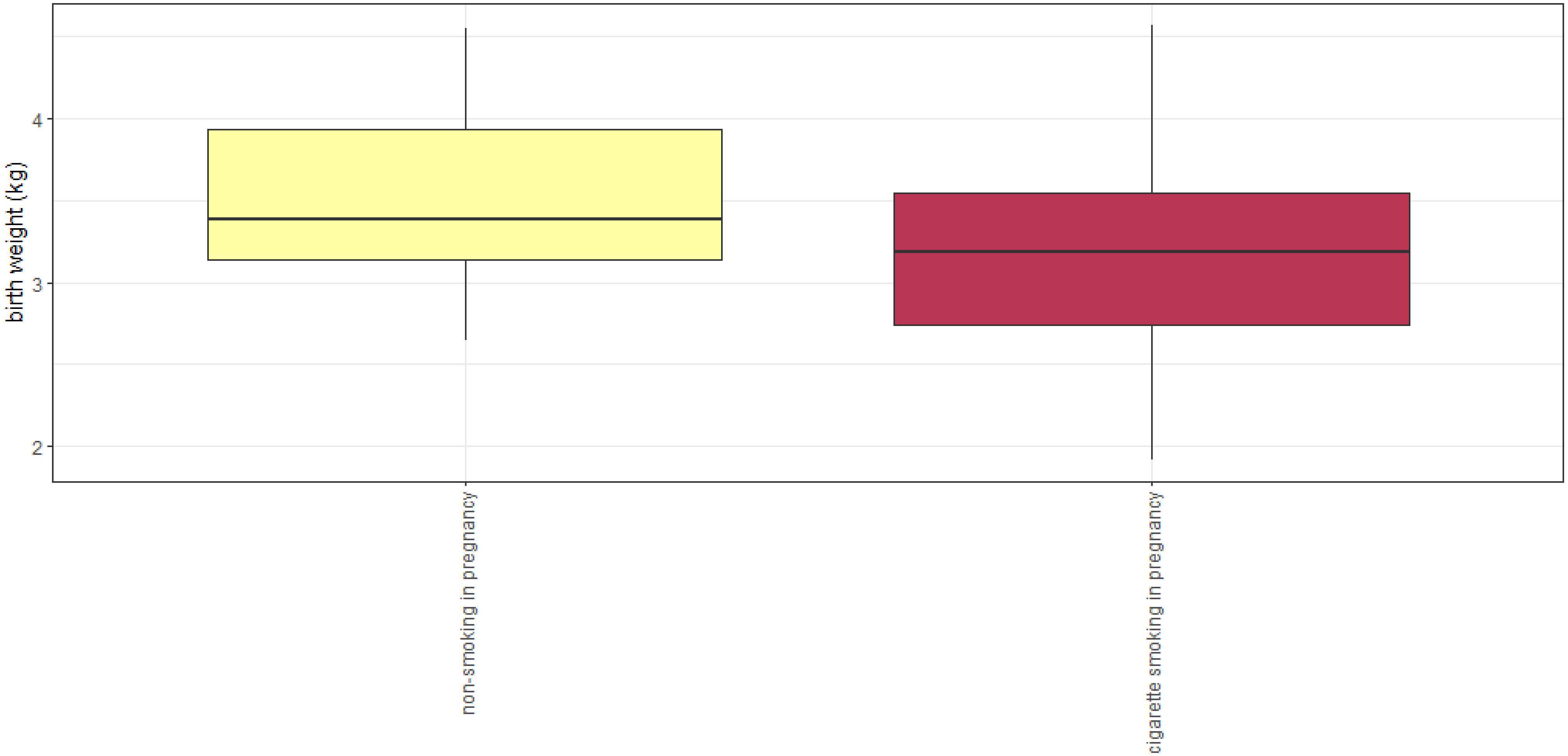
Changing the direction of axes labels

```
ggplot(data = birthdata, mapping = aes(x = smoker, y = birthweight, fill =
smoker)) + geom_boxplot() + scale_fill_manual(values = smoking.palette) +
scale_x_discrete(labels = c("non-smoking in pregnancy", "cigarette smoking in
pregnancy")) + guides(fill = "none") + labs(y = "birth weight (kg)") + theme_bw()
+ theme(axis.title.x = element_blank(), axis.text.x = element_text(angle = 90,
vjust = 0.5, hjust = 1))
```

This last part helps us change angles of labels

```
 + theme(axis.title.x = element_blank(), axis.text.x = element_text(angle = 90,
vjust = 0.5, hjust = 1))
```

Changed label axis plot



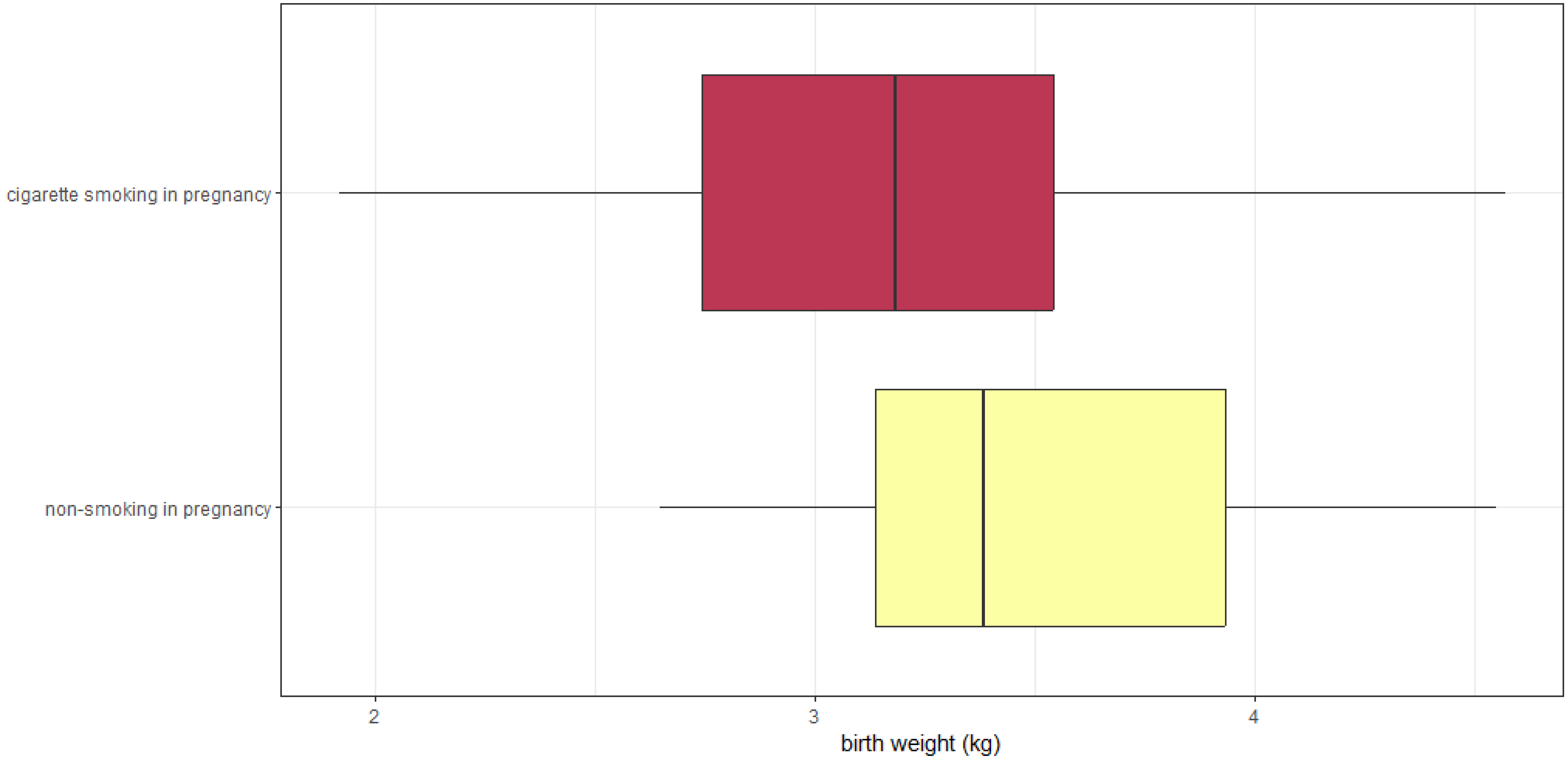
Changing the direction of axes itself

```
ggplot(data = birthdata, mapping = aes(x = smoker, y = birthweight, fill =
smoker)) + geom_boxplot() + scale_fill_manual(values = smoking.palette) +
scale_x_discrete(labels = c("non-smoking in pregnancy", "cigarette smoking in
pregnancy")) + guides(fill = "none") + labs(y = "birth weight (kg)") +
coord_flip() + theme_bw() + theme(axis.title.y = element_blank())
```

This last part helps us change angles of axis itself

```
 + coord_flip()
```

Changed axis plot

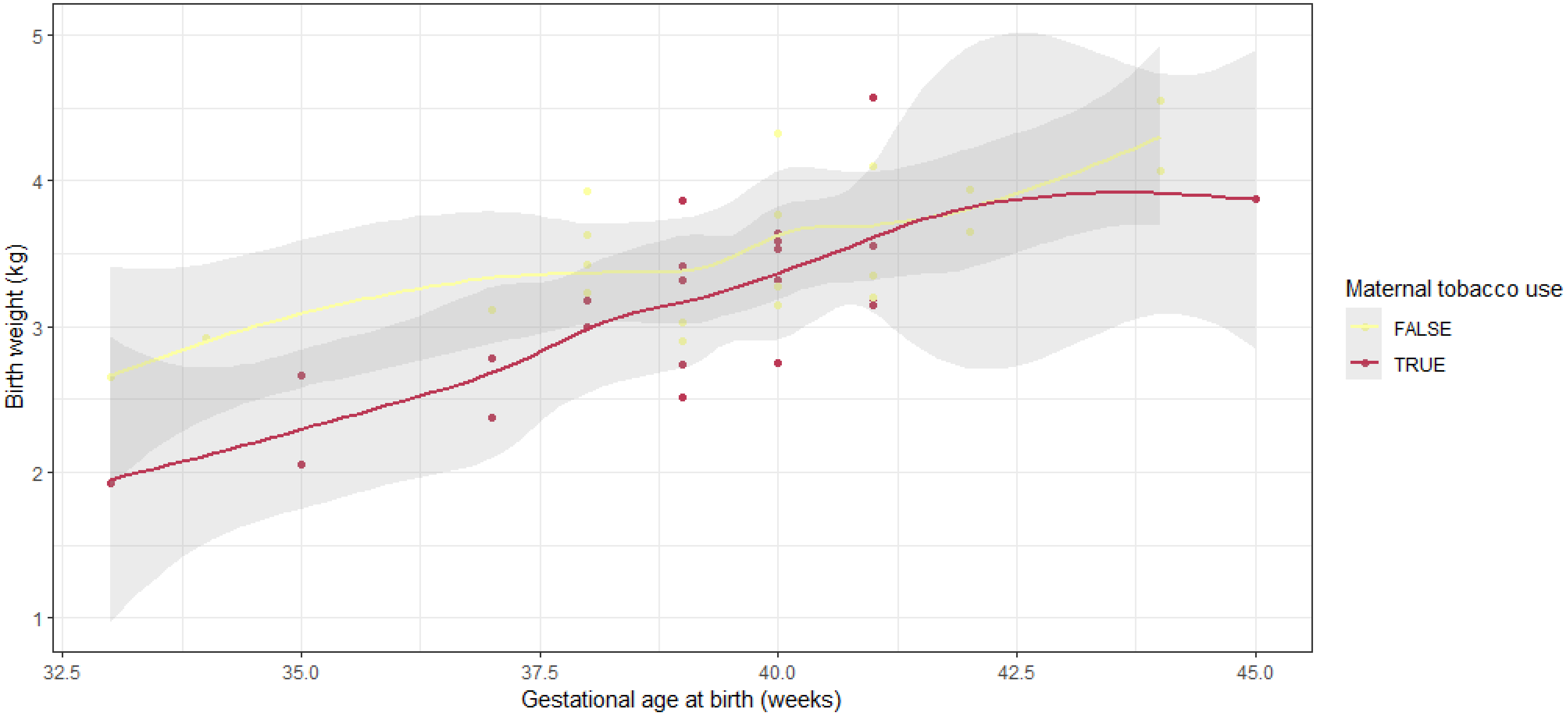


Layer multiple geoms

We used geom_point and geom_smooth here together.

```
ggplot(birthdata, mapping = aes(x = weeks.gestation, y = birthweight, color =
smoker)) + geom_point() + geom_smooth(alpha = 0.2) + labs(x = "Gestational age at
birth (weeks)", y = "Birth weight (kg)", color = "Maternal tobacco use", caption
= "Birthweight increases with gestational age for infants born to both\nsmokers
and non-smokers.") + scale_color_manual(values = smoking.palette) + theme_bw() +
theme(plot.caption = element_text(hjust = 0))
```

multiple geoms plot



Birthweight increases with gestational age for infants born to both
smokers and non-smokers.

Remember :

If its point or line of colors, then :

color = data

from above examples : `color = smoker`

Also,

If its an area to be filled by a color, then :

fill = data

from above examples : `fill = smoker`