

## Data Visualization – Part 2

### Data

	state	expenditure	pupil_teacher_ratio	salary	read	math	write	total	sat_pct	ptr	sal	SAT_rate
1	Alabama	10	15.3	49948	556	550	544	1650	8	ptr - high	sal - low	low
2	Alaska	17	16.2	62654	518	515	491	1524	52	ptr - high	sal - high	medium
3	Arizona	9	21.4	49298	519	525	500	1544	28	ptr - high	sal - low	low
4	Arkansas	10	14.1	49033	566	566	552	1684	5	ptr - low	sal - low	low
5	California	10	24.1	71611	501	516	500	1517	53	ptr - high	sal - high	medium
6	Colorado	10	17.4	51660	568	572	555	1695	19	ptr - high	sal - low	low
7	Connecticut	16	13.1	67565	509	514	513	1536	87	ptr - low	sal - high	high
8	Delaware	13	14.5	59932	493	495	481	1469	74	ptr - low	sal - high	high
9	Florida	9	15.1	49042	496	498	479	1473	64	ptr - high	sal - low	high
10	Georgia	10	14.9	55766	488	490	475	1453	80	ptr - low	sal - high	high
11	Hawaii	13	15.8	57814	483	505	470	1458	64	ptr - high	sal - high	high
12	Idaho	7	17.6	48596	543	541	517	1601	20	ptr - high	sal - low	low
13	Illinois	13	15.7	65179	585	600	577	1762	5	ptr - high	sal - high	low

We added three categorical variables to the dataset (SAT\_2010):

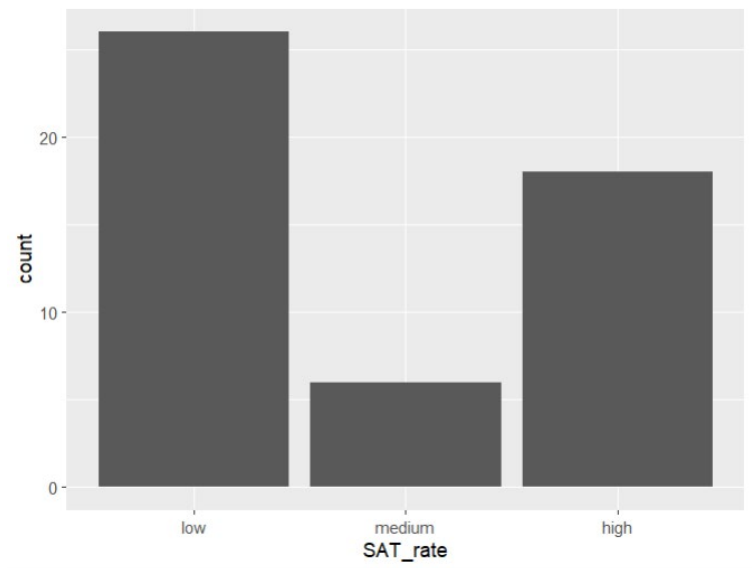
```
SAT_2010 <- SAT_2010 %>%  
  mutate(ptr = ifelse(pupil_teacher_ratio >= 15, "ptr - high", "ptr -  
    low"),  
         sal = ifelse(salary >= 52000, "sal - high", "sal - low"),  
         SAT_rate = cut(  
           sat_pct,  
           breaks = c(0, 30, 60, 100),  
           labels = c("low", "medium", "high")  
         )  
  )
```

# Multivariate Displays

## Bar Graphs

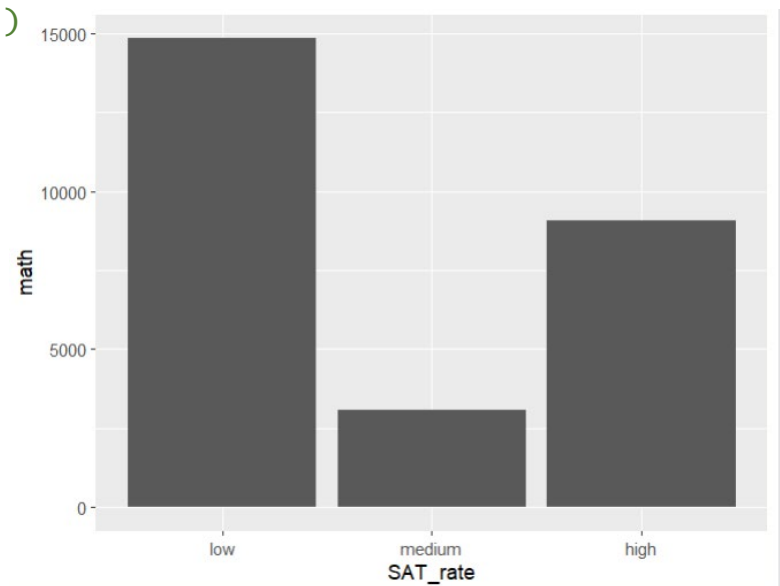
**Figure 1:** Make a bar graph with SAT\_rate. Notice that this is a One Variable Bar Graph (it counts by default)

```
fig_1 <- SAT_2010 %>%  
  ggplot(aes(x = SAT_rate)) +  
  geom_bar()  
fig_1
```



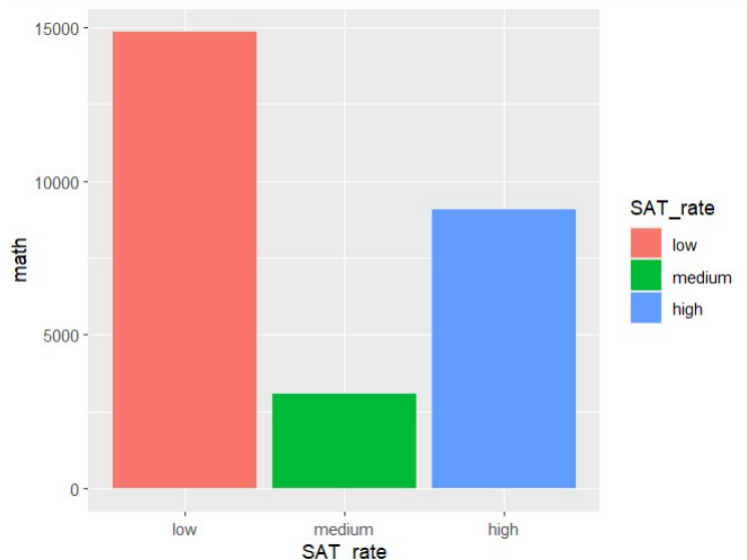
**Figure 2:** Make a bar graph with SAT\_rate on the x axis and The Average Math Score on the y axis. Notice that this is a two Variable Bar Graph (you need stat = "identity")

```
fig_2 <- SAT_2010 %>%  
  ggplot(aes(x = SAT_rate, y = math)) +  
  geom_bar(stat = "identity")  
fig_2
```



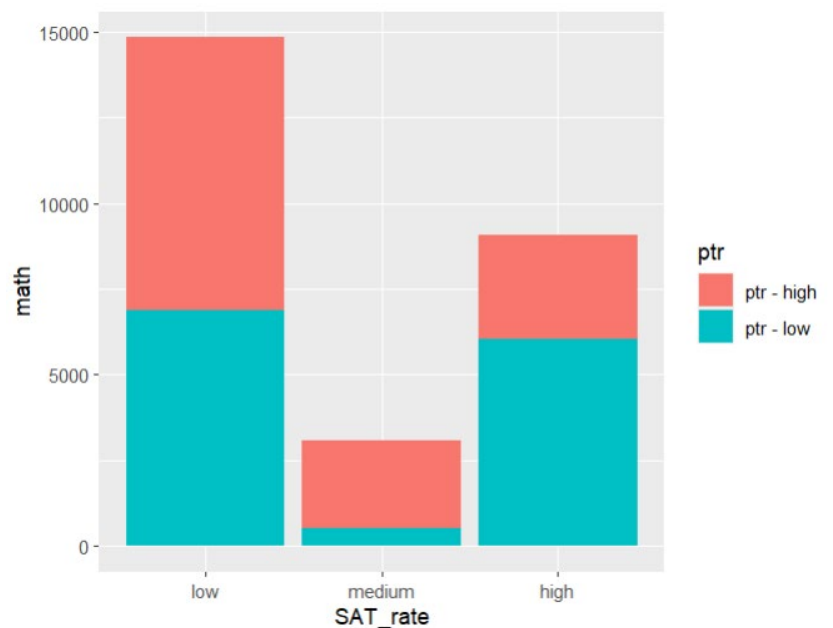
**Figure 3:** Make a bar graph with SAT\_rate on the x axis and The Average Math Score on the y axis. Make every column a different color.

```
fig_3 <- SAT_2010 %>%
  ggplot(aes(x = SAT_rate, y = math, fill = SAT_rate)) +
  geom_bar(stat = "identity")
fig_3
```



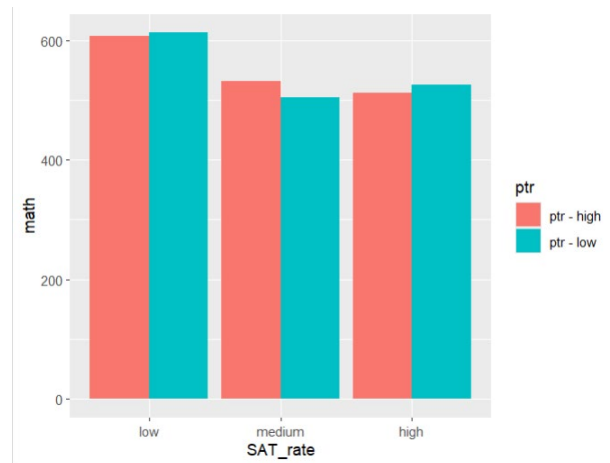
**Figure 4:** (Stacking by a third variable). Make a bar graph with SAT\_rate on the x axis and The Average Math Score on the y axis. Stack the bars by the variable ptr.

```
fig_4 <- SAT_2010 %>%
  ggplot(aes(x = SAT_rate, y = math, fill = ptr)) +
  geom_bar(stat = "identity")
fig_4
```



**Figure 5:** (Grouped Bar Graph). Make a bar graph with SAT\_rate on the x axis and The Average Math Score on the y axis. Group the bars by the variable ptr.

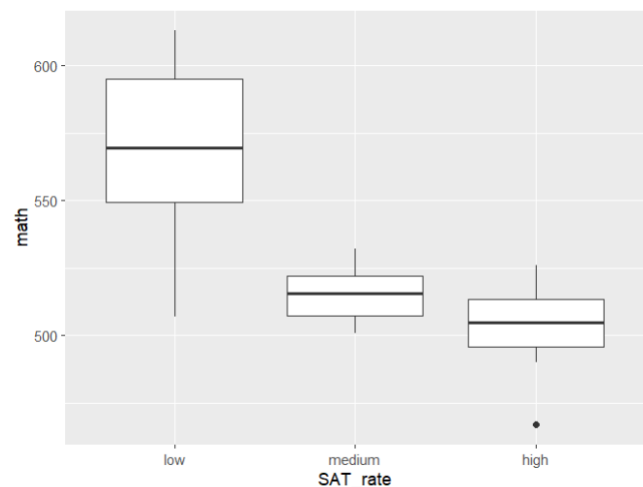
```
fig_5 <- SAT_2010 %>%  
  ggplot(aes(x = SAT_rate, y = math, fill = ptr)) +  
  geom_bar(stat = "identity", position = "dodge")  
fig_5
```



## Box Plots

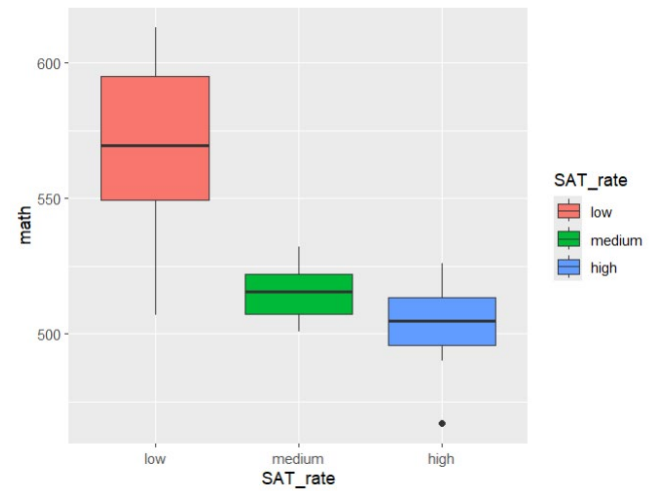
**Figure 6:** Make side by side box plots with SAT\_rate on the x axis and The Average Math Score on the y axis.

```
fig_6 <- SAT_2010 %>%  
  ggplot(aes(x = SAT_rate, y = math)) +  
  geom_boxplot()  
fig_6
```



**Figure 7:** Make side by side box plots with SAT\_rate on the x axis and The Average Math Score on the y axis. Change the filling color of each SAT\_rate.

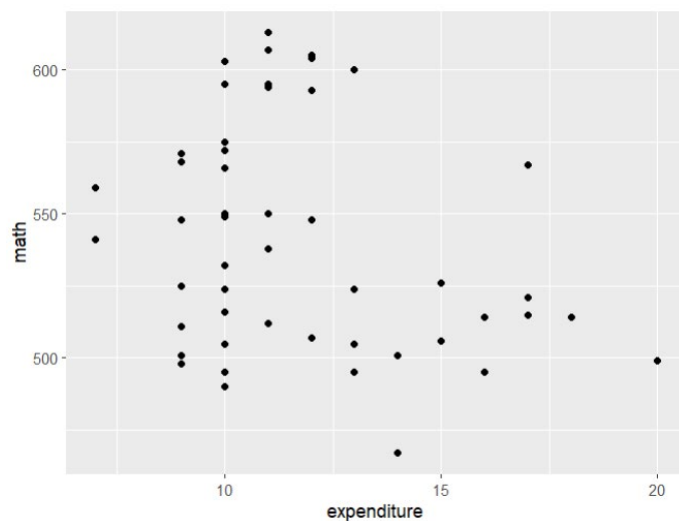
```
fig_7 <- SAT_2010 %>%  
  ggplot(aes(x = SAT_rate, y = math, fill = SAT_rate)) +  
  geom_boxplot()  
fig_7
```



## Scatter Plots

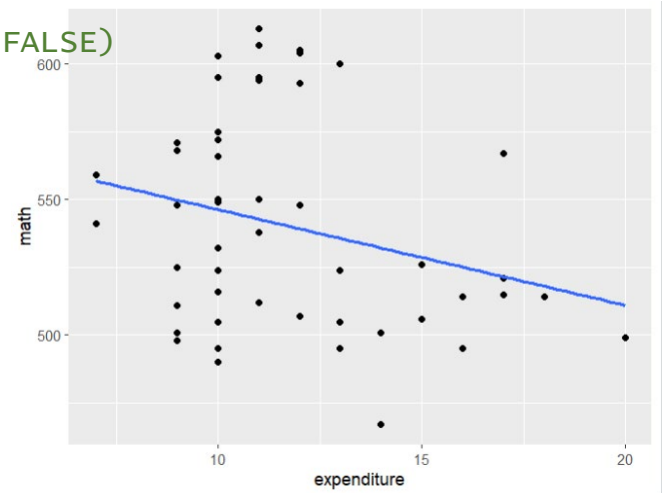
**Figure 8:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score.

```
fig_8 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math)) +  
  geom_point()  
fig_8
```



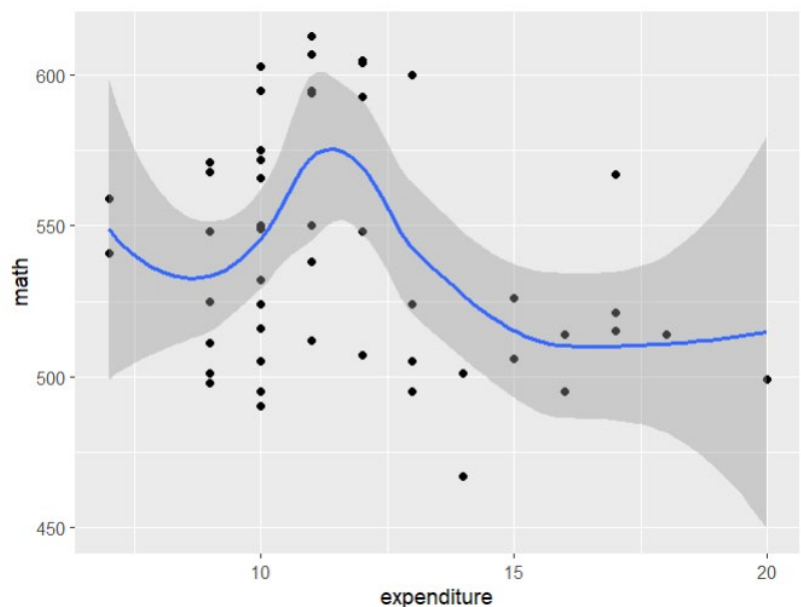
**Figure 9:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and add a trend line with ggplot.

```
fig_9 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math)) +  
  geom_point() +  
  geom_smooth(method = "lm", se = FALSE)  
fig_9
```



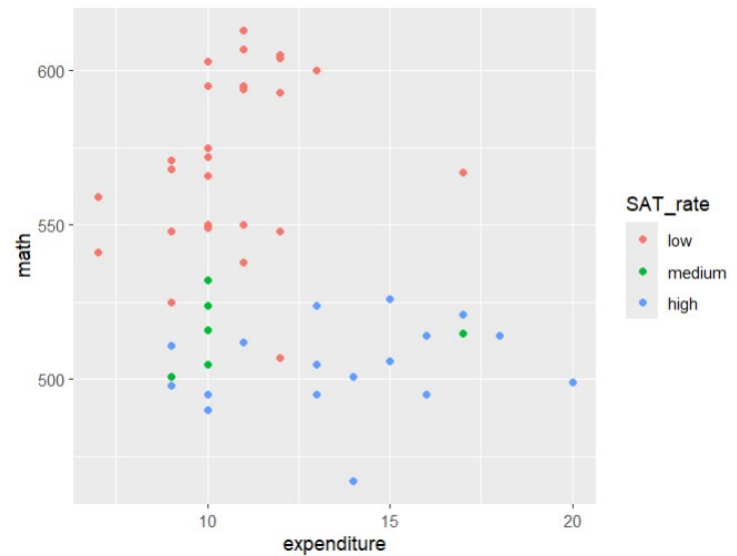
**Figure 10:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and add a polynomial fitting with the standard error band.

```
fig_10 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math)) +  
  geom_point() +  
  geom_smooth(method = "loess", se = TRUE)  
fig_10
```



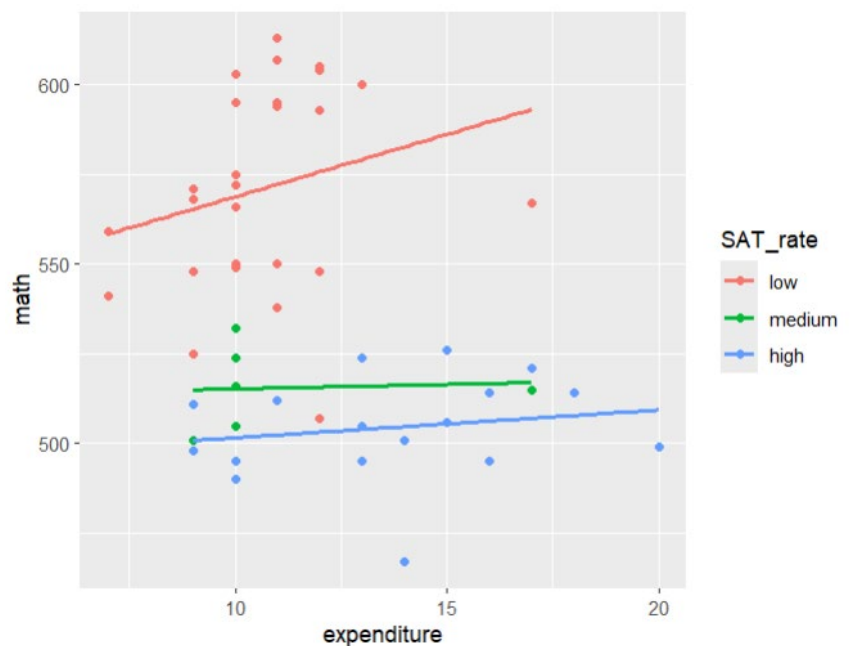
**Figure 11:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and split the data with different colors by SAT\_rate.

```
fig_11 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math, color = SAT_rate)) +  
  geom_point()  
fig_11
```



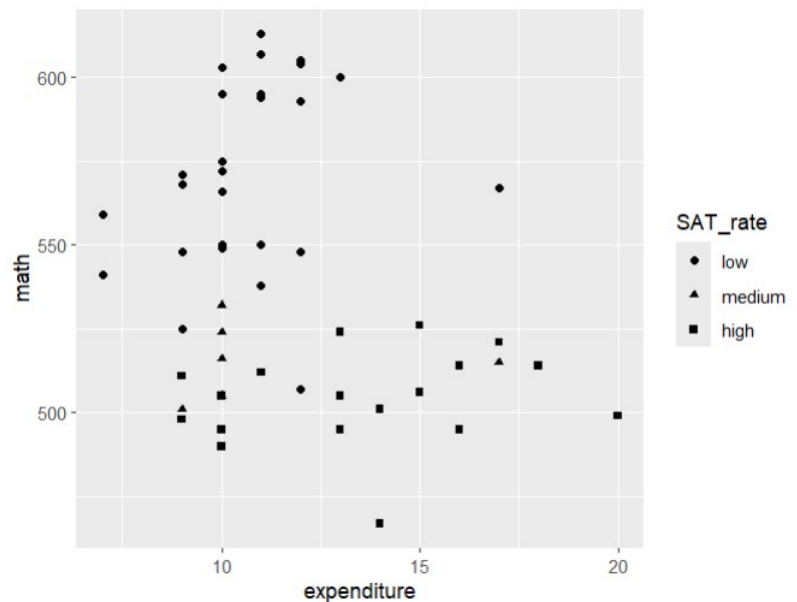
**Figure 12:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and split the data with different colors by SAT\_rate. Add a trend line.

```
fig_12 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math, color = SAT_rate)) +  
  geom_point() +  
  geom_smooth(method = "lm", se = FALSE)  
fig_12
```



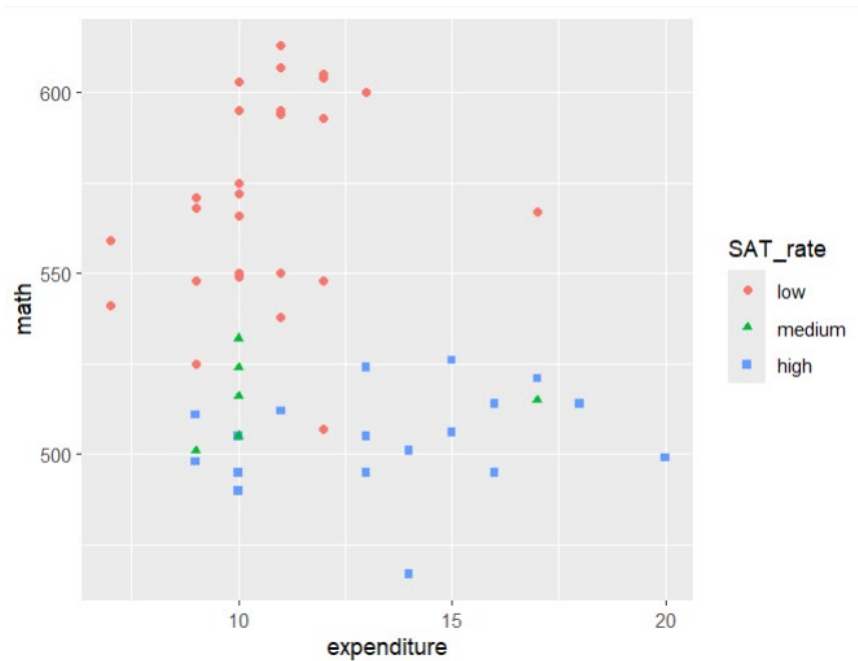
**Figure 13:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and split the data with different shapes by SAT\_rate.

```
fig_13 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math, shape = SAT_rate)) +  
  geom_point()  
fig_13
```



**Figure 14:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and split the data with different shapes and colors by SAT\_rate.

```
fig_14 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math, color = SAT_rate, shape =  
SAT_rate)) +  
  geom_point()  
fig_14
```





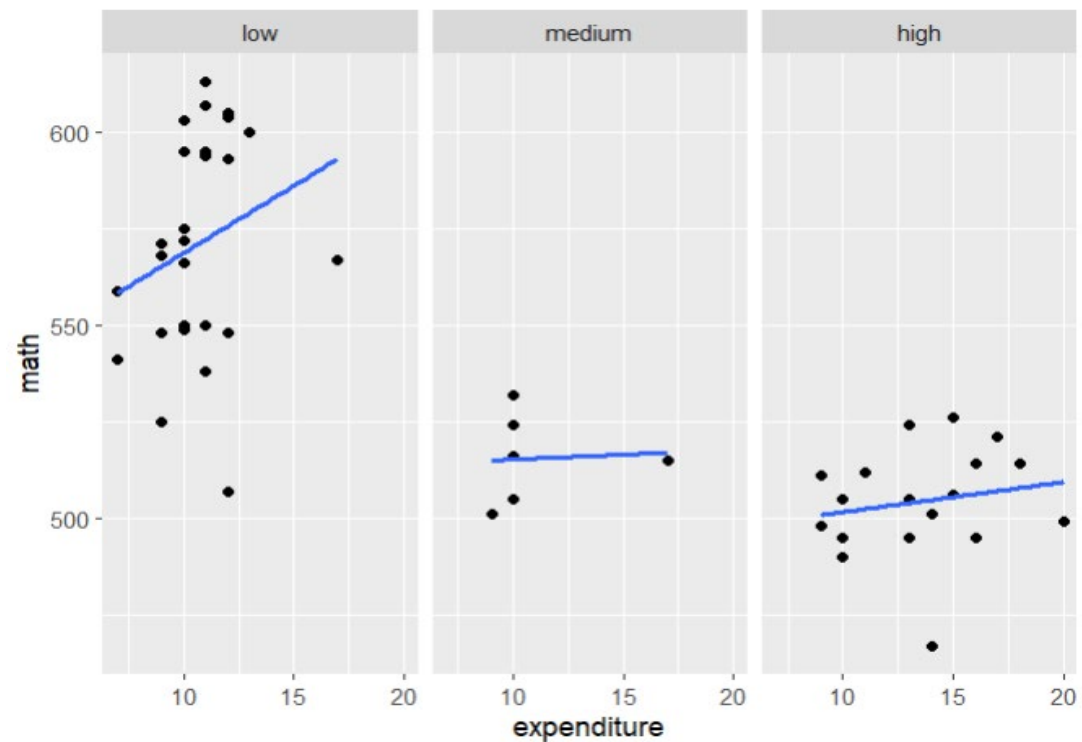
## Faceting

This is similar to using shape or color for a categorical variables but puts them on separate plots.

### *Facet with 1 variable*

**Figure 15:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and split the data by SAT\_rate where each category is a separate plot. Include a trend line.

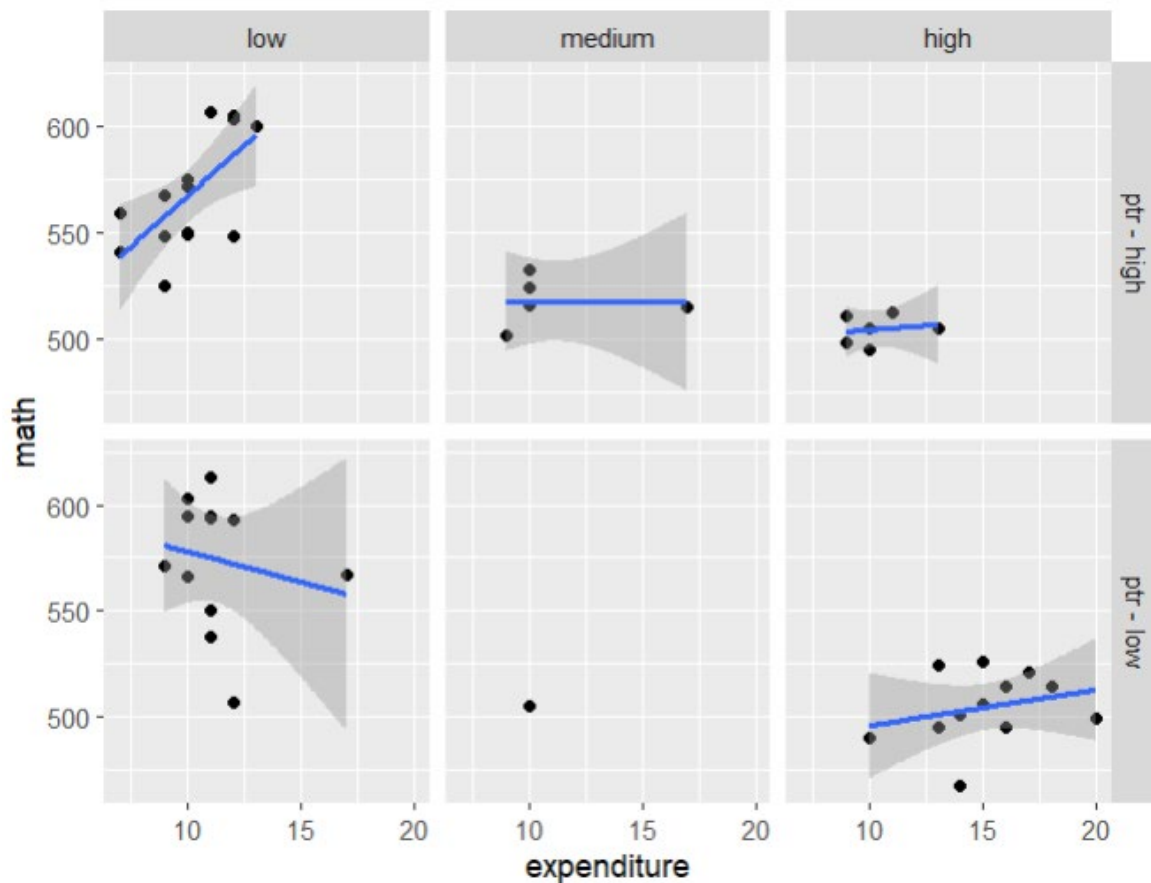
```
fig_15 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math)) +  
  geom_point() +  
  geom_smooth(method = "lm", se = FALSE) +  
  facet_wrap(~SAT_rate)  
fig_15
```



### Facet with 2 variables

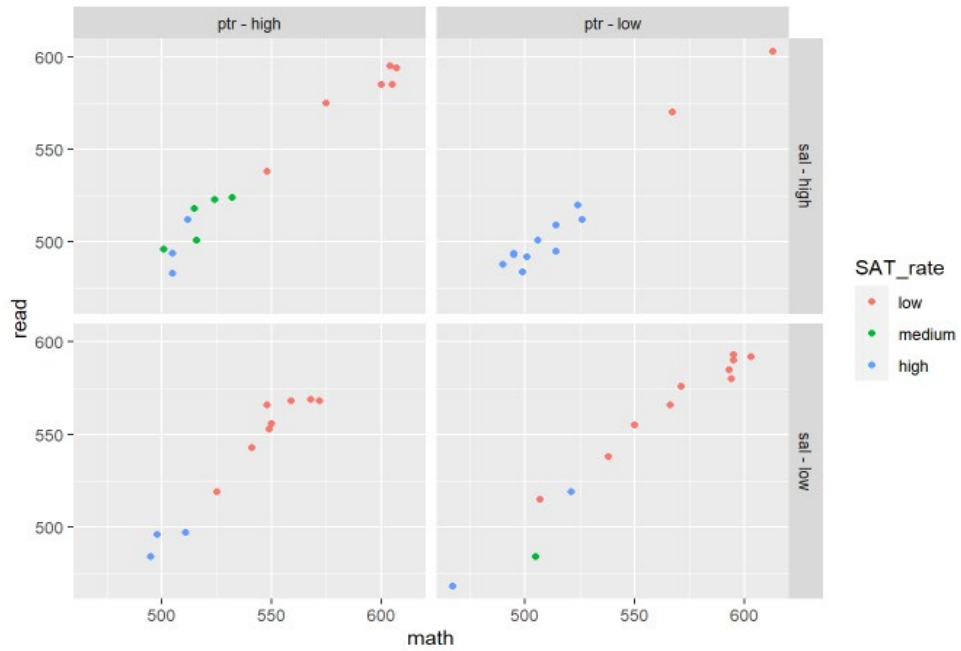
**Figure 16:** Create a Scatter Plot on the Expenditure and The Average Math SAT Score and split the data by SAT\_rate and ptr where each pair of categories is a separate plot. Include a trend line with a standard error band.

```
fig_16 <- SAT_2010 %>%  
  ggplot(aes(x = expenditure, y = math)) +  
  geom_point() +  
  geom_smooth(method = "lm", se = TRUE) +  
  facet_grid(ptr ~ SAT_rate)  
fig_16
```

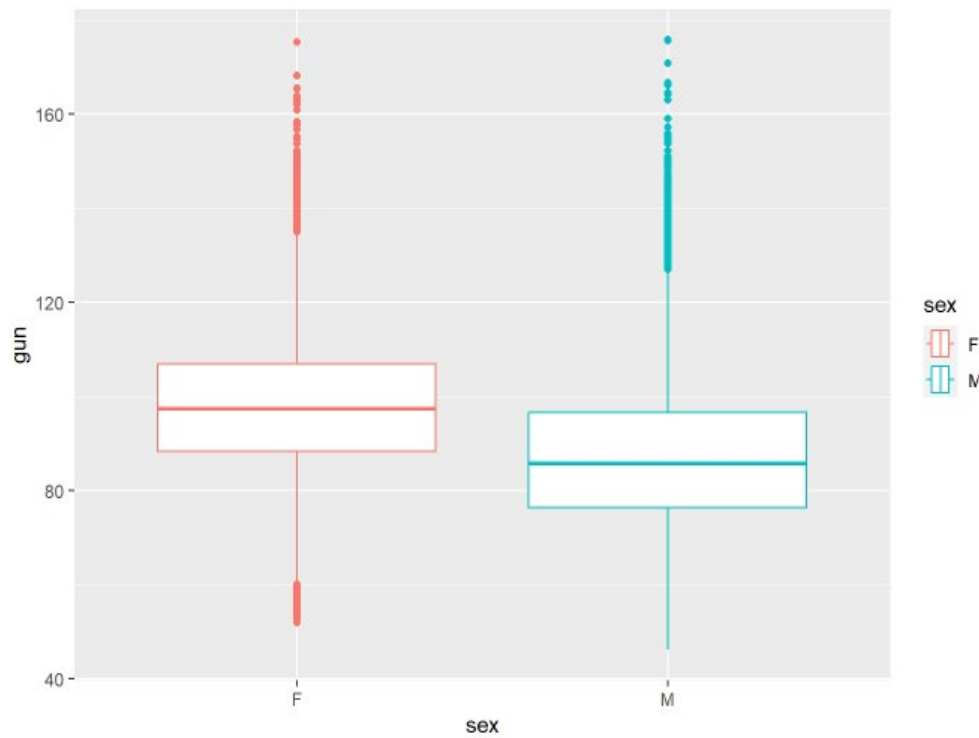


## Do it Yourself – Recreate These Plots

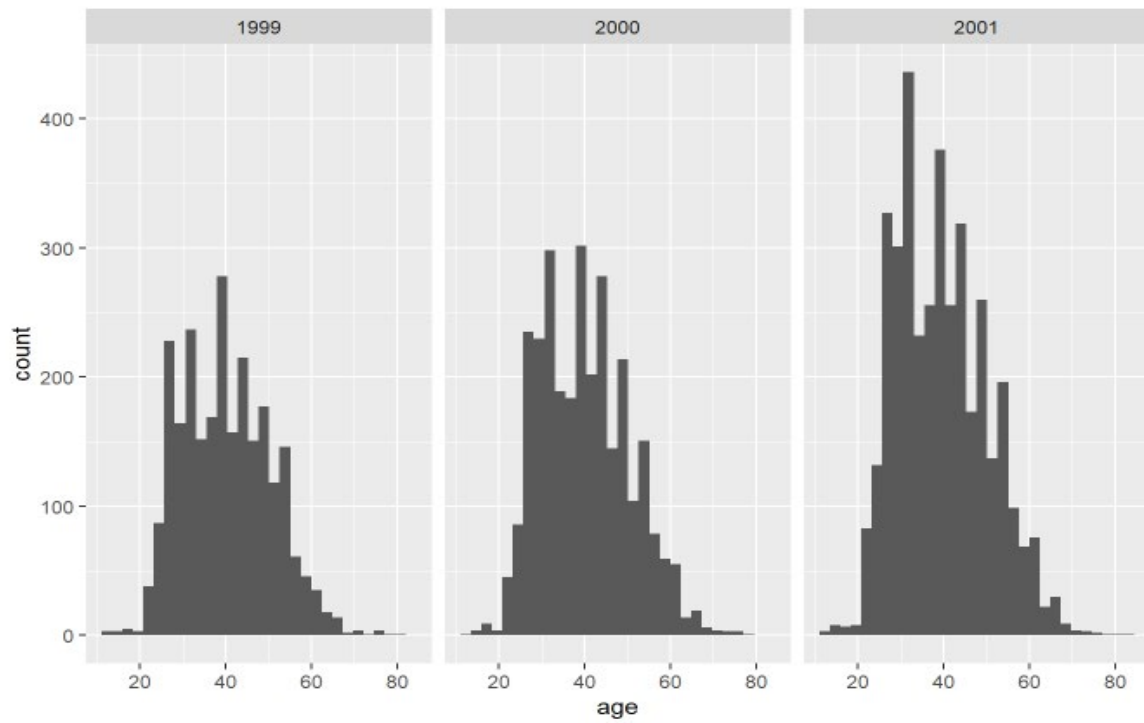
### Plot # 1



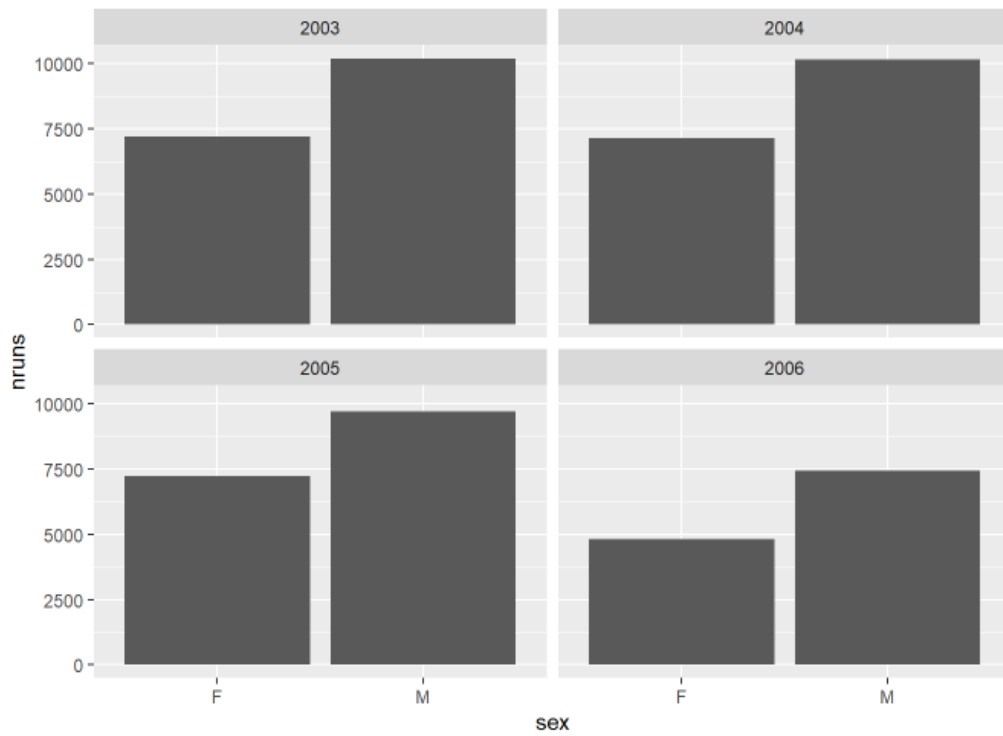
### Plot # 2



**Plot # 3**



**Plot # 4**



## Plot # 5

