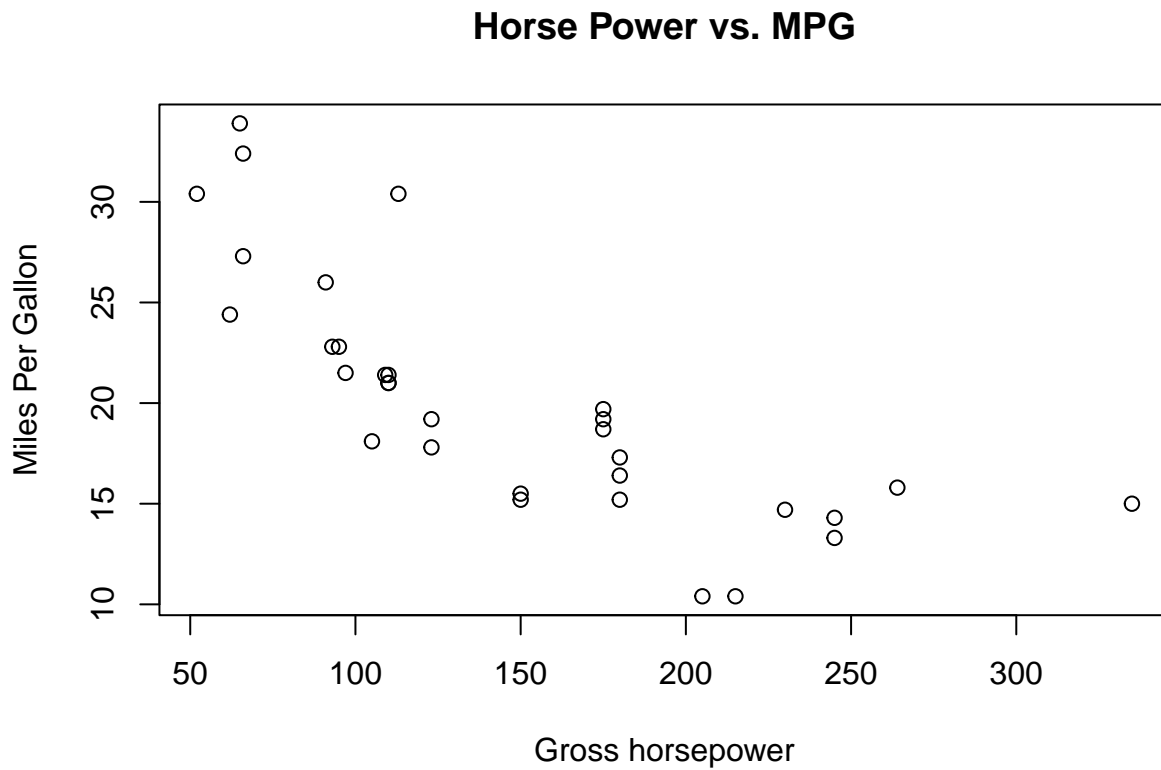


## R to Plot Interaction Effects

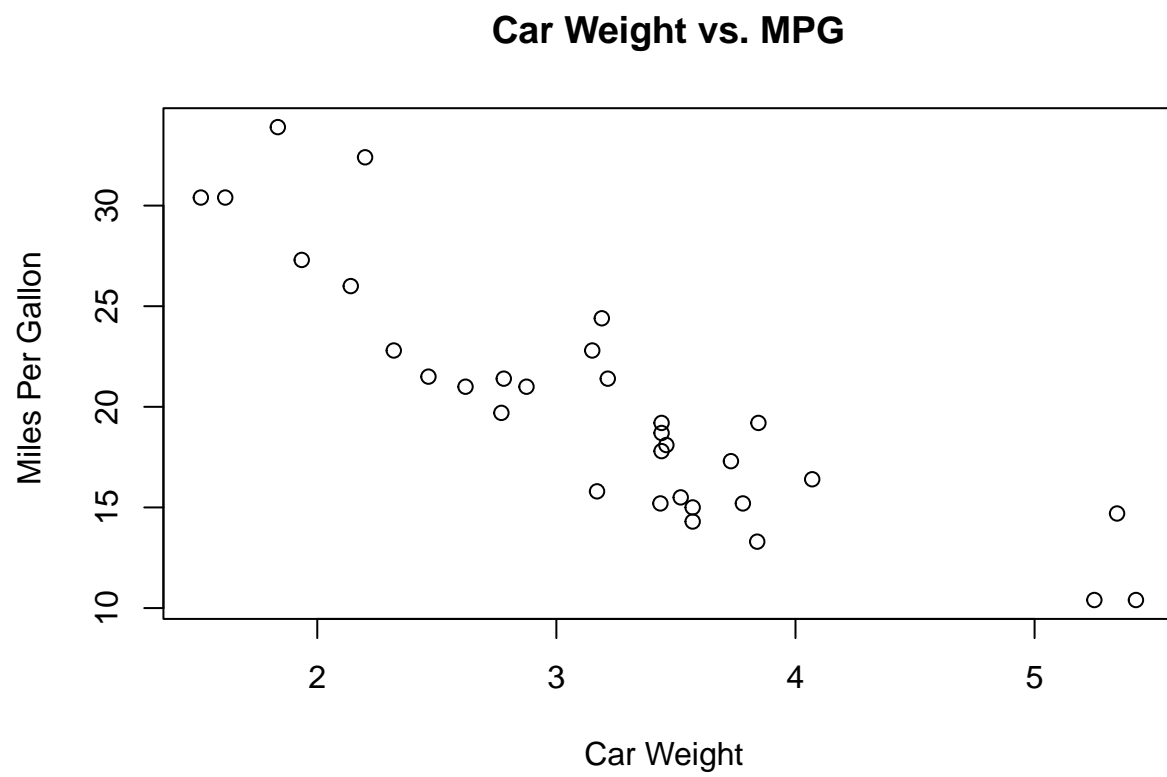
This PDF is part of a YouTube tutorial ([https://youtu.be/\\_QyFj3mKe7Q](https://youtu.be/_QyFj3mKe7Q)). This PDF is for individual, personal usage only.

$$mpg = b_0 + b_1 hp + b_2 wt + b_3 hp * wt$$

```
# explore the data
attach(mtcars)
plot(hp, mpg, main="Horse Power vs. MPG", xlab="Gross horsepower", ylab="Miles Per Gallon")
```



```
plot(wt, mpg, main="Car Weight vs. MPG", xlab="Car Weight ", ylab="Miles Per Gallon ")
```



```
# install.packages("interactions")
library(interactions)
```

```
## Warning: package 'interactions' was built under R version 4.1.3
```

```
# linear model for Example 1
example_1 <- lm(mpg ~ hp * wt, data = mtcars)
summary(example_1)
```

```
##
## Call:
## lm(formula = mpg ~ hp * wt, data = mtcars)
##
## Residuals:
```

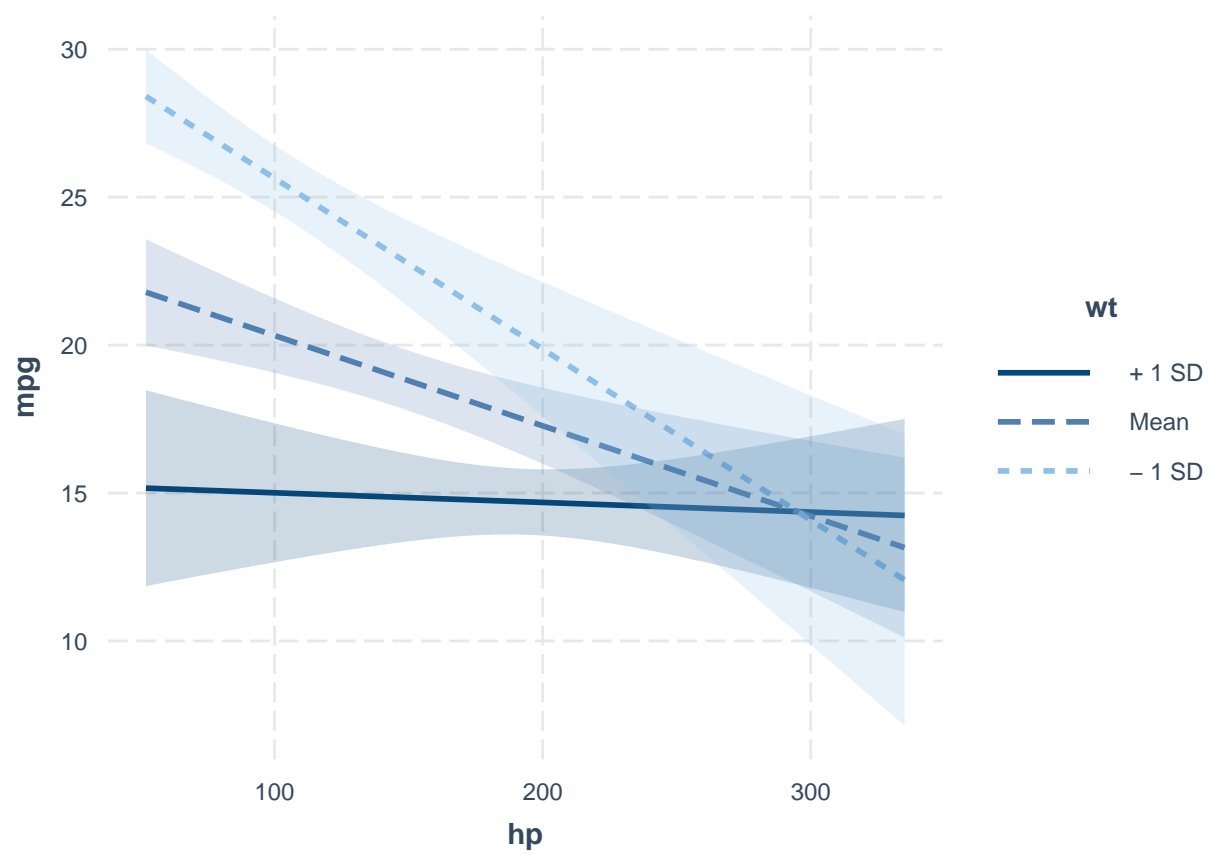
	Min	1Q	Median	3Q	Max
	-3.0632	-1.6491	-0.7362	1.4211	4.5513

```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	49.80842	3.60516	13.816	5.01e-14 ***
hp	-0.12010	0.02470	-4.863	4.04e-05 ***
wt	-8.21662	1.26971	-6.471	5.20e-07 ***
hp:wt	0.02785	0.00742	3.753	0.000811 ***

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.153 on 28 degrees of freedom
## Multiple R-squared:  0.8848, Adjusted R-squared:  0.8724
## F-statistic: 71.66 on 3 and 28 DF, p-value: 2.981e-13
```

```
# plot the interaction  
interact_plot(example_1, pred = hp, modx = wt, interval = TRUE)
```



```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.1.3
```

```
##
```

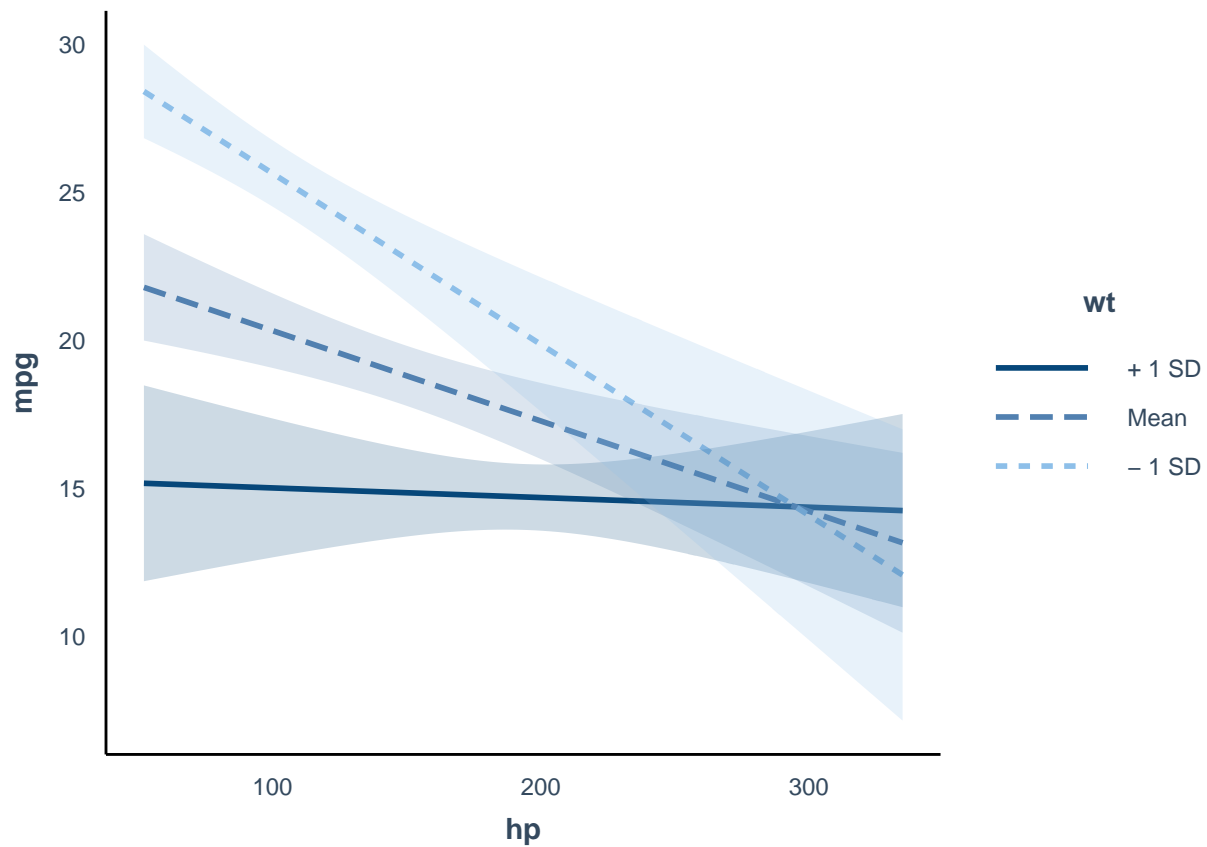
```
## Attaching package: 'ggplot2'
```

```
## The following object is masked from 'mtcars':
```

```
##
```

```
##      mpg
```

```
interact_plot(example_1, pred = hp, modx = wt, interval = TRUE)+ theme(panel.grid.major = element_blank(),  
panel.background = element_blank(), axis.line = element_line(colour = "black"))
```



```
sim_slopes(example_1, pred = hp, modx = wt, johnson_neyman = FALSE)
```

```
## SIMPLE SLOPES ANALYSIS
```

```
##
```

```
## Slope of hp when wt = 2.238793 (- 1 SD):
```

```
##
```

##	Est.	S.E.	t val.	p
##	-0.06	0.01	-5.66	0.00

```
##
```

```
## Slope of hp when wt = 3.217250 (Mean):
```

```
##
```

##	Est.	S.E.	t val.	p
##	-0.03	0.01	-4.07	0.00

```
##
```

```
## Slope of hp when wt = 4.195707 (+ 1 SD):
```

```
##
```

##	Est.	S.E.	t val.	p
##	-0.00	0.01	-0.31	0.76

```
education_data <- read.csv("https://raw.githubusercontent.com/TidyPython/SPSS/main/hsbdemo.csv")
head(education_data)
```

```
##   V1  id female    ses schtyp    prog read write math science socst
## 1  1  45 female   low public vocation  34  35  41    29    26
## 2  2 108  male middle public  general  34  33  41    36    36
## 3  3  15  male  high public vocation  39  39  44    26    42
## 4  4  67  male   low public vocation  37  37  42    33    32
## 5  5 153  male middle public vocation  39  31  40    39    51
## 6  6  51 female  high public  general  42  36  42    31    39
##      honors awards cid Gender_dummy
## 1 not enrolled      0  1           1
## 2 not enrolled      0  1           0
## 3 not enrolled      0  1           0
## 4 not enrolled      0  1           0
## 5 not enrolled      0  1           0
## 6 not enrolled      0  1           1
```

$$write = b_0 + b_1 socst + b_2 female + b_3 socst * female$$

```
example_2 <- lm(write ~ female * socst, data = education_data)
summary(example_2)
```

```
##
## Call:
## lm(formula = write ~ female * socst, data = education_data)
##
## Residuals:
```

	Min	1Q	Median	3Q	Max
##	-18.6265	-4.3108	-0.0645	5.0429	16.4974

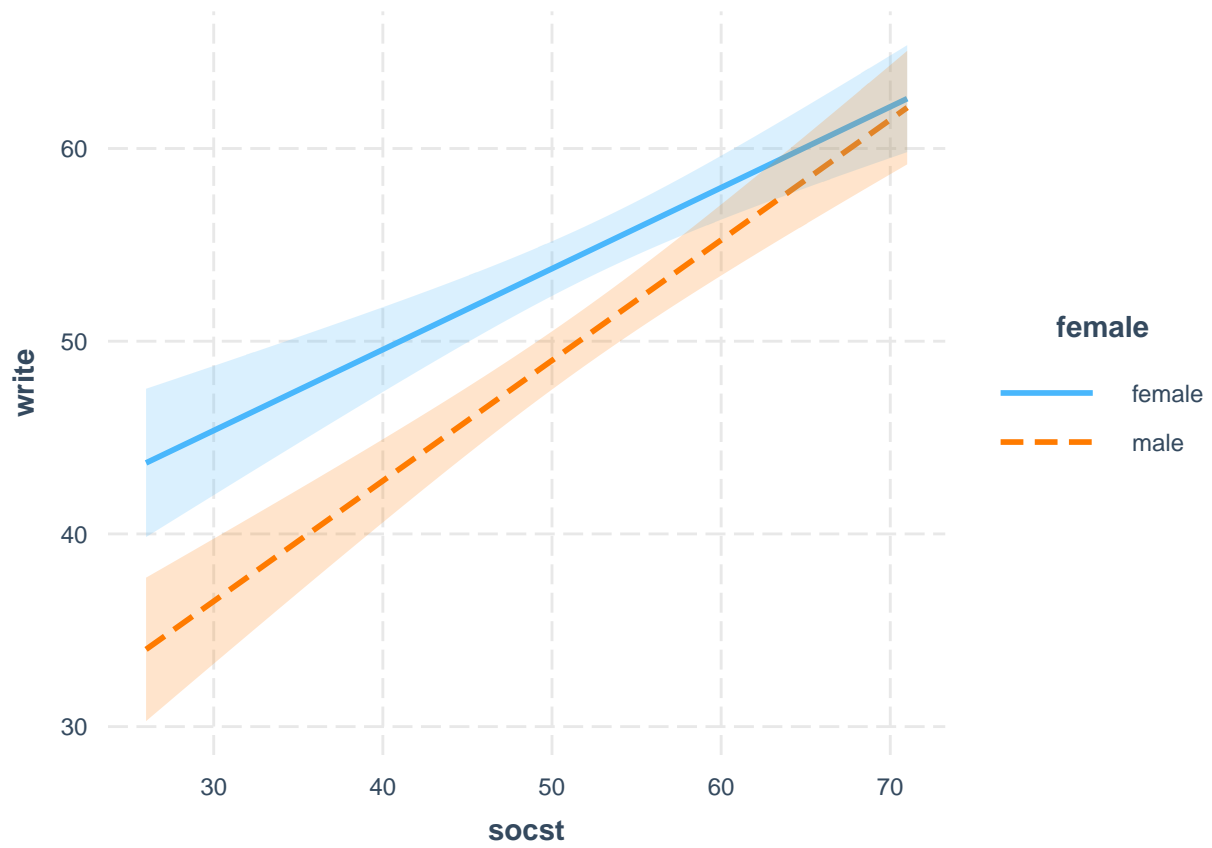
```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t )
## (Intercept)	32.76190	3.65392	8.966	2.45e-16 ***
## femalemale	-15.00001	5.09795	-2.942	0.00365 **
## socst	0.42007	0.06780	6.195	3.36e-09 ***
## femalemale:socst	0.20473	0.09537	2.147	0.03305 *

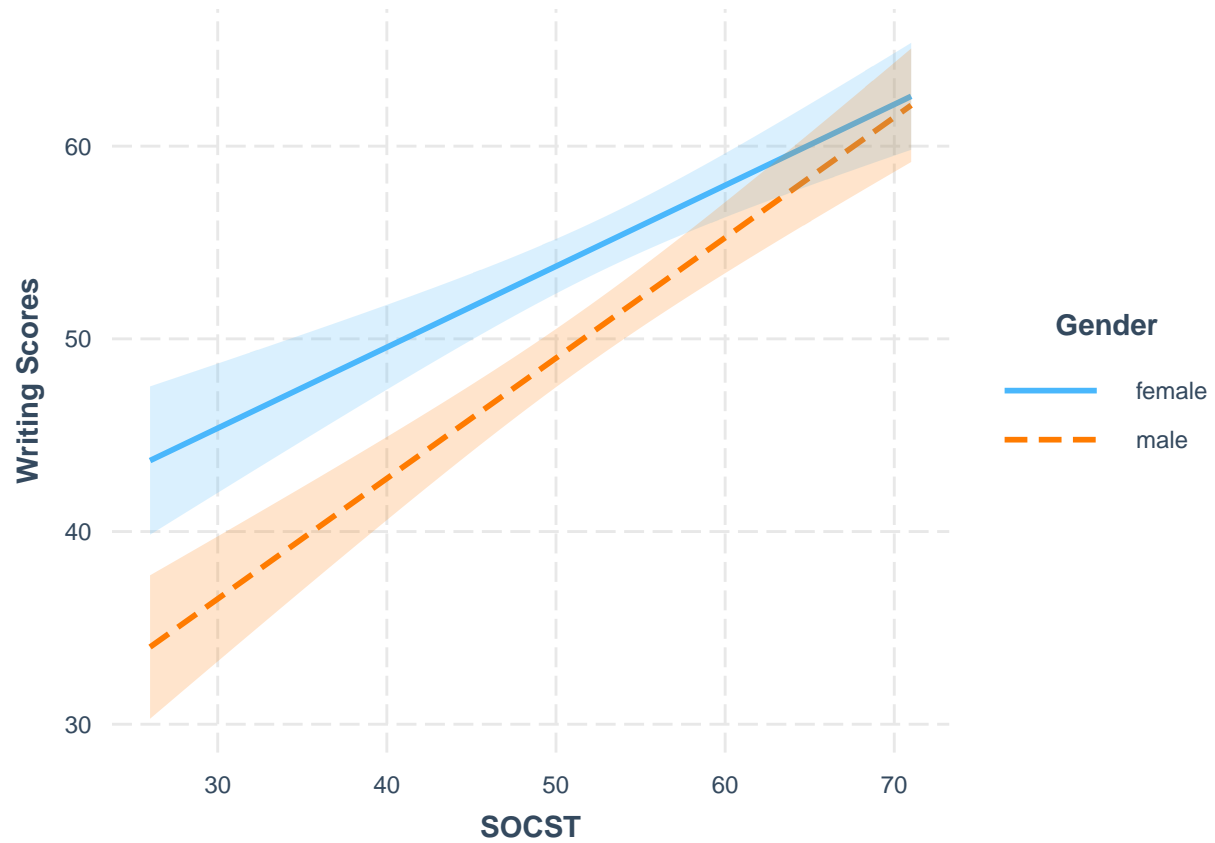
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.212 on 196 degrees of freedom
## Multiple R-squared:  0.4299, Adjusted R-squared:  0.4211
## F-statistic: 49.26 on 3 and 196 DF,  p-value: < 2.2e-16
```



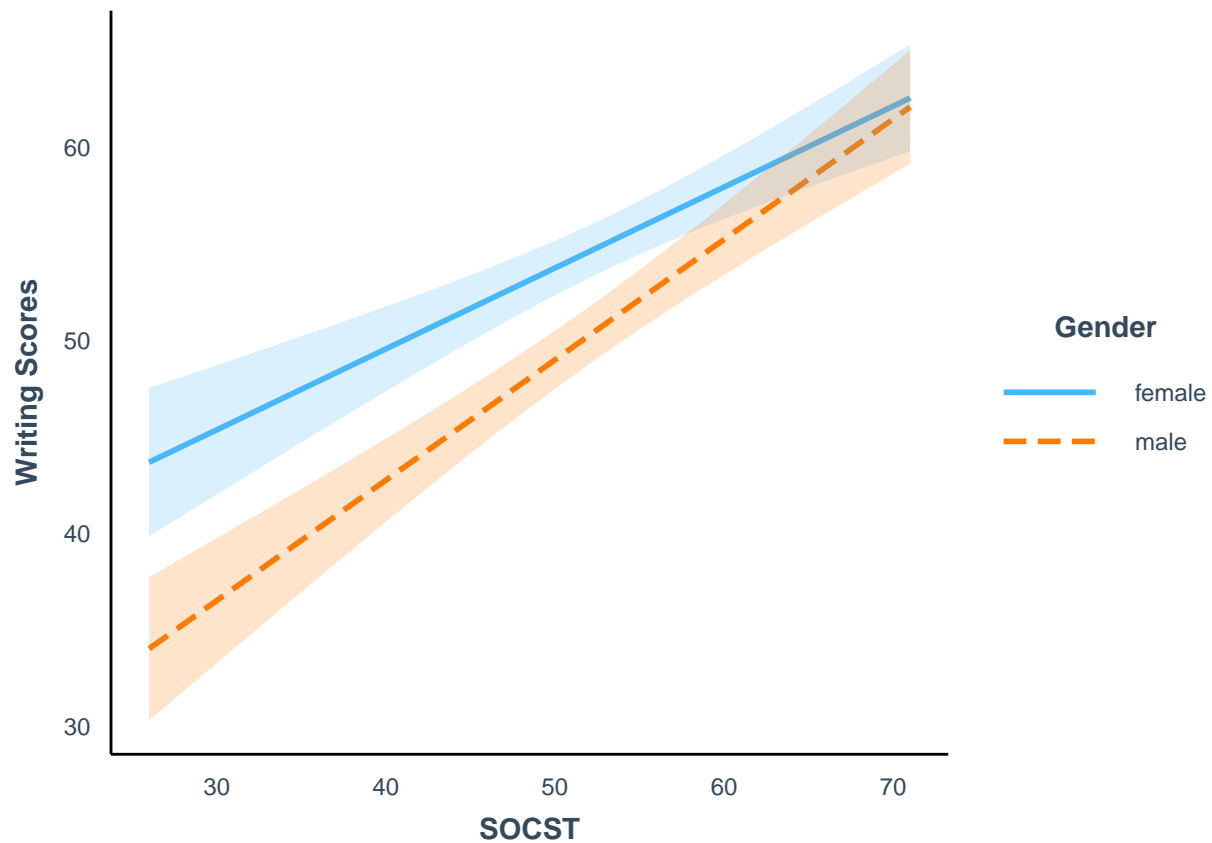
```
interact_plot(example_2, pred = socst, modx = female, interval = TRUE)
```



```
interact_plot(example_2, pred = socst, modx = female,  
              interval = TRUE, x.label = "SOCST",  
              y.label = "Writing Scores",  
              legend.main = "Gender")
```



```
library(ggplot2)
interact_plot(example_2, pred = socst,
              modx = female, interval = TRUE, x.label = "SOCST",
              y.label = "Writing Scores", legend.main = "Gender")+
  theme(panel.grid.major = element_blank(),
        panel.grid.minor = element_blank(),
        panel.background = element_blank(),
        axis.line = element_line(colour = "black"))
```



```
sim_slopes(example_2, pred = socst, modx = female, johnson_neyman = FALSE)
```

```
## SIMPLE SLOPES ANALYSIS
##
## Slope of socst when female = male:
##
##   Est.   S.E.   t val.    p
## ----
##   0.62   0.07    9.32    0.00
##
## Slope of socst when female = female:
##
##   Est.   S.E.   t val.    p
## ----
##   0.42   0.07    6.20    0.00
```