In [1]:
```
data(mtcars)
```

In [2]:
```
mtcars
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

In [3]:
```
attach(mtcars)
```

In [4]:
```
cor(mtcars)
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
mpg	1.0000000	-0.8521620	-0.8475514	-0.7761684	0.68117191	-0.8676594	0.41868403	0.6640389	0.59983243	0.4802848	-0.5509250
cyl	-0.8521620	1.0000000	0.9020329	0.8324475	-0.69993811	0.7824958	-0.59124207	-0.8108118	-0.52260705	-0.4926866	0.5269882
disp	-0.8475514	0.9020329	1.0000000	0.7909486	-0.71021393	0.8879799	-0.43369788	-0.7104159	-0.59122704	-0.5555692	0.3949768
hp	-0.7761684	0.8324475	0.7909486	1.0000000	-0.44875912	0.6587479	-0.70822339	-0.7230967	-0.24320426	-0.1257043	0.7498124
drat	0.6811719	-0.6999381	-0.7102139	-0.4487591	1.00000000	-0.7124406	0.09120476	0.4402785	0.71271113	0.6996101	-0.0907898
wt	-0.8676594	0.7824958	0.8879799	0.6587479	-0.71244065	1.0000000	-0.17471588	-0.5549157	-0.69249526	-0.5832870	0.4276059
qsec	0.4186840	-0.5912421	-0.4336979	-0.7082234	0.09120476	-0.1747159	1.00000000	0.7445354	-0.22986086	-0.2126822	-0.6562492
vs	0.6640389	-0.8108118	-0.7104159	-0.7230967	0.44027846	-0.5549157	0.74453544	1.0000000	0.16834512	0.2060233	-0.5696071
am	0.5998324	-0.5226070	-0.5912270	-0.2432043	0.71271113	-0.6924953	-0.22986086	0.1683451	1.00000000	0.7940588	0.0575343
gear	0.4802848	-0.4926866	-0.5555692	-0.1257043	0.69961013	-0.5832870	-0.21268223	0.2060233	0.79405876	1.0000000	0.2740728
carb	-0.5509251	0.5269883	0.3949769	0.7498125	-0.09078980	0.4276059	-0.65624923	-0.5696071	0.05753435	0.2740728	1.0000000

In [5]:
```
cor(mpg,mtcars)
```

mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	-0.852162	-0.8475514	-0.7761684	0.6811719	-0.8676594	0.418684	0.6640389	0.5998324	0.4802848	-0.5509251

In [8]:
```
library(ggplot2)
```

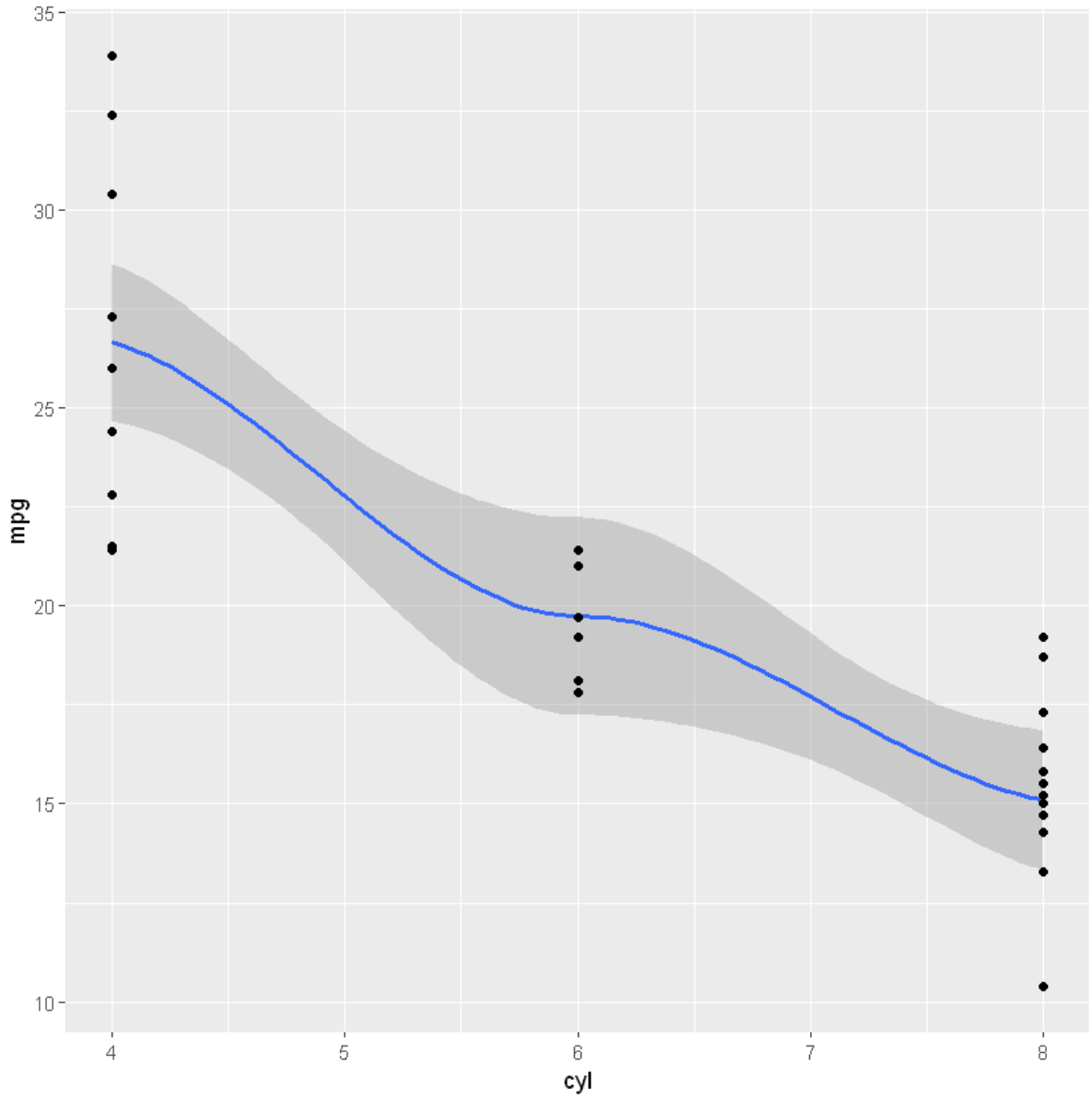
```
Warning message:
"package 'ggplot2' was built under R version 3.6.3"
Attaching package: 'ggplot2'

The following object is masked from 'mtcars':

    mpg
```

In [10]:
```
ggplot(mtcars, aes(x = cyl ,y = mpg)) + stat_smooth()+ geom_point()
```

```
`geom_smooth()` using method = 'loess' and formula 'y ~ x'
Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"pseudoinverse used at 3.98"Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"neighborhood radius 4.02"Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"reciprocal condition number  7.3088e-017"Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"There are other near singularities as well. 16.16"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x
else if (is.data.frame(newdata)) as.matrix(model.frame(delete.response(terms(object)), :
"pseudoinverse used at 3.98"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x else if (is.data.frame
(newdata)) as.matrix(model.frame(delete.response(terms(object)), :
"neighborhood radius 4.02"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x else if (is.data.frame(ne
wdata)) as.matrix(model.frame(delete.response(terms(object)), :
"reciprocal condition number  6.4525e-017"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x else if
(is.data.frame(newdata)) as.matrix(model.frame(delete.response(terms(object)), :
"There are other near singularities as well. 16.16"
```



In [11]:
```
model = lm(mpg~cyl, data = mtcars)
model
```

```
Call:
lm(formula = mpg ~ cyl, data = mtcars)

Coefficients:
(Intercept)          cyl
     37.885       -2.876
```

In [12]:
```
summary(model)
```

```
Call:
lm(formula = mpg ~ cyl, data = mtcars)

Residuals:
    Min      1Q  Median      3Q     Max
-4.9814 -2.1185  0.2217  1.0717  7.5186

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  37.8846     2.0738   18.27  < 2e-16 ***
cyl          -2.8758     0.3224   -8.92 6.11e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.206 on 30 degrees of freedom
Multiple R-squared:  0.7262,    Adjusted R-squared:  0.7171
F-statistic: 79.56 on 1 and 30 DF,  p-value: 6.113e-10
```

In [14]:
```
column <- names(mtcars)
column
```

```
'mpg'  'cyl'  'disp'  'hp'  'drat'  'wt'  'qsec'  'vs'  'am'  'gear'  'carb'
```

In [19]:
```
summary(mtcars)
```

```
      mpg             cyl             disp             hp
 Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0
 1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5
 Median :19.20   Median :6.000   Median :196.3   Median :123.0
 Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7
 3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0
 Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0
      drat             wt             qsec             vs
 Min.   :2.760   Min.   :1.513   Min.   :14.50   Min.   :0.0000
 1st Qu.:3.080   1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000
 Median :3.695   Median :3.325   Median :17.71   Median :0.0000
 Mean   :3.597   Mean   :3.217   Mean   :17.85   Mean   :0.4375
 3rd Qu.:3.920   3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000
 Max.   :4.930   Max.   :5.424   Max.   :22.90   Max.   :1.0000
       am              gear            carb
 Min.   :0.0000   Min.   :3.000   Min.   :1.000
 1st Qu.:0.0000   1st Qu.:3.000   1st Qu.:2.000
 Median :0.0000   Median :4.000   Median :2.000
 Mean   :0.4062   Mean   :3.688   Mean   :2.812
 3rd Qu.:1.0000   3rd Qu.:4.000   3rd Qu.:4.000
 Max.   :1.0000   Max.   :5.000   Max.   :8.000
```

In [24]:
```
nrow(mtcars)
```

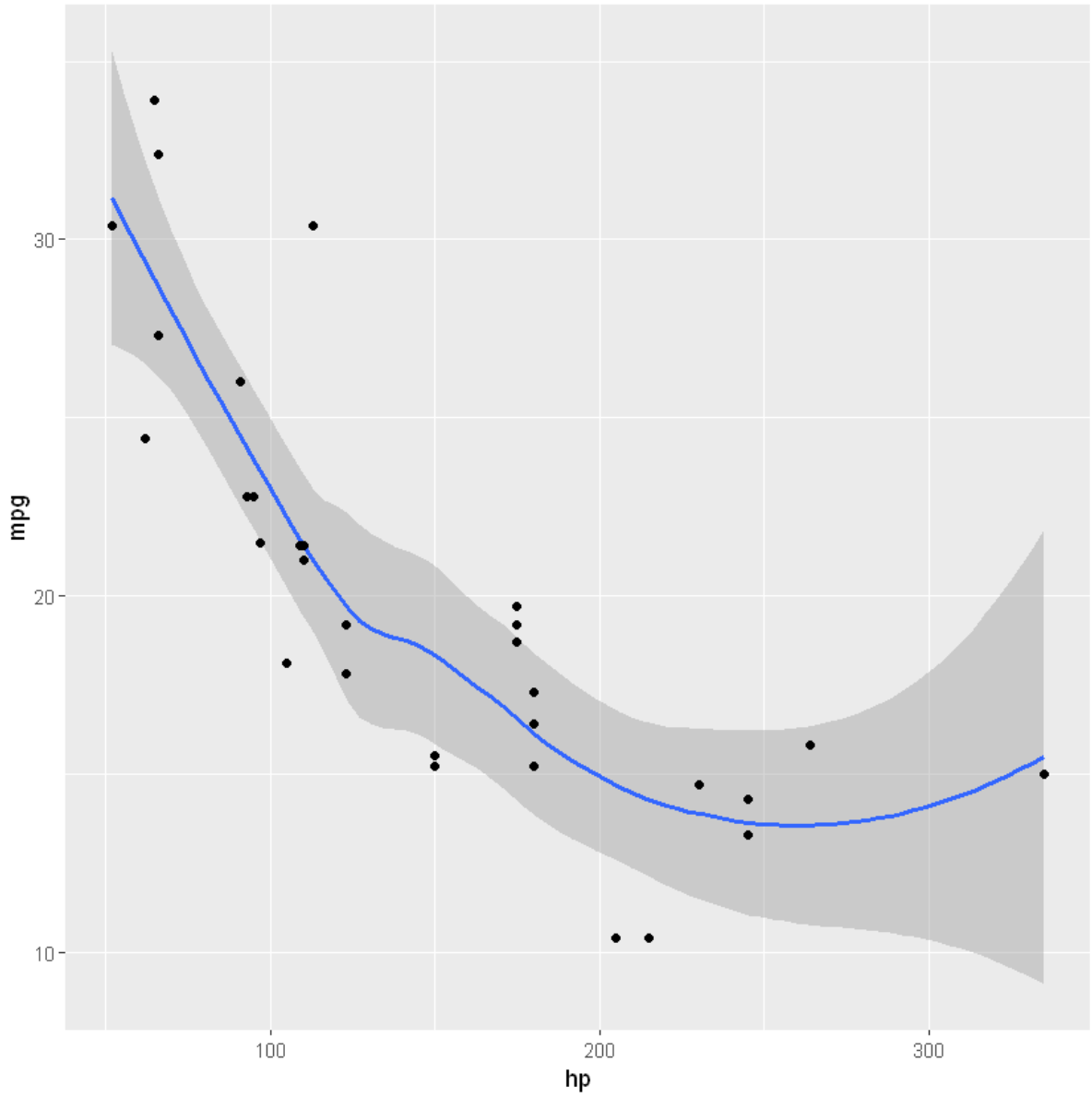
```
32
```

In [30]:
```
ncol(mtcars)
```

```
11
```

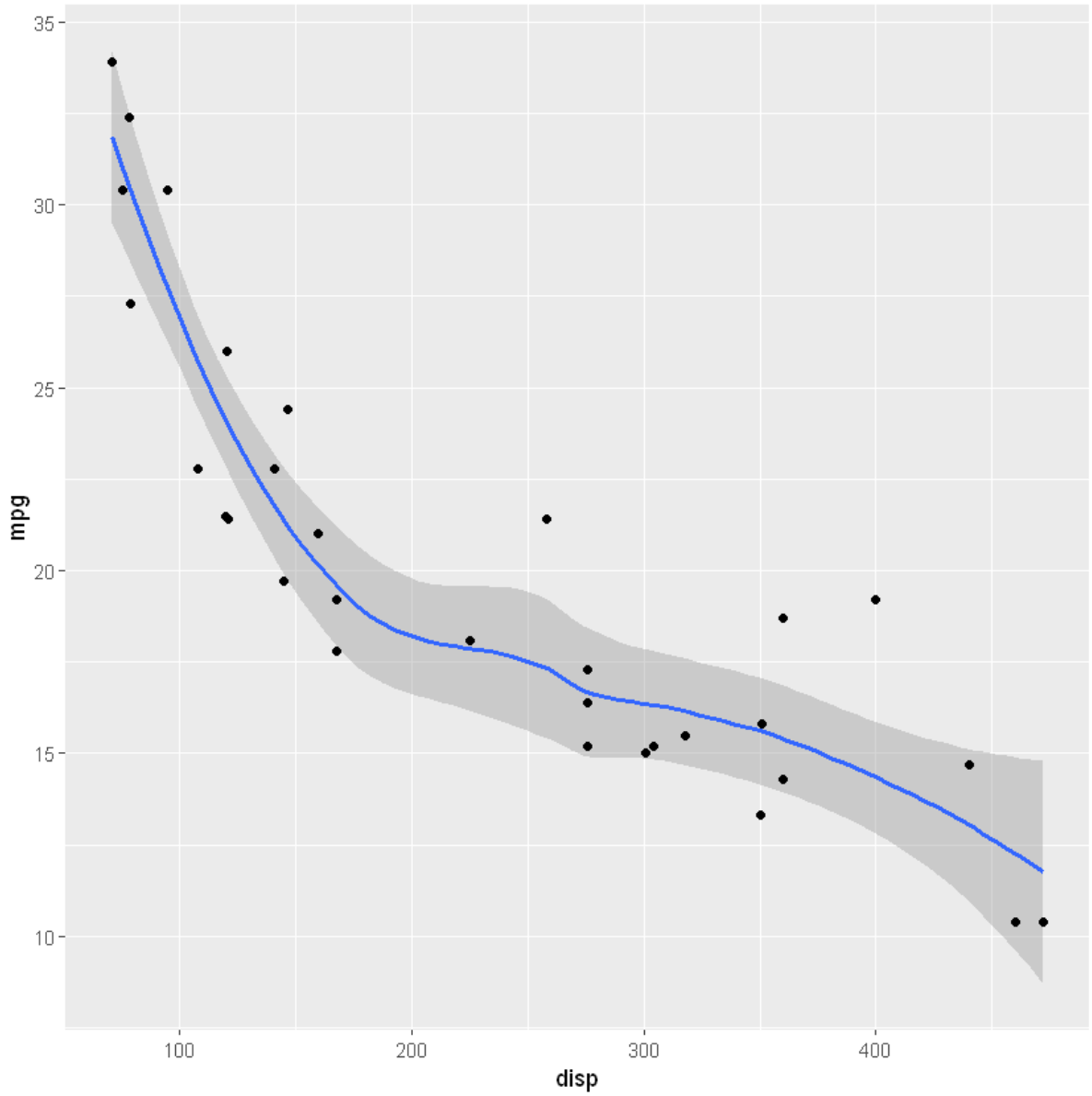
In [38]:
```
ggplot(mtcars, aes(x = hp ,y = mpg)) + stat_smooth()+ geom_point()
```

```
`geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

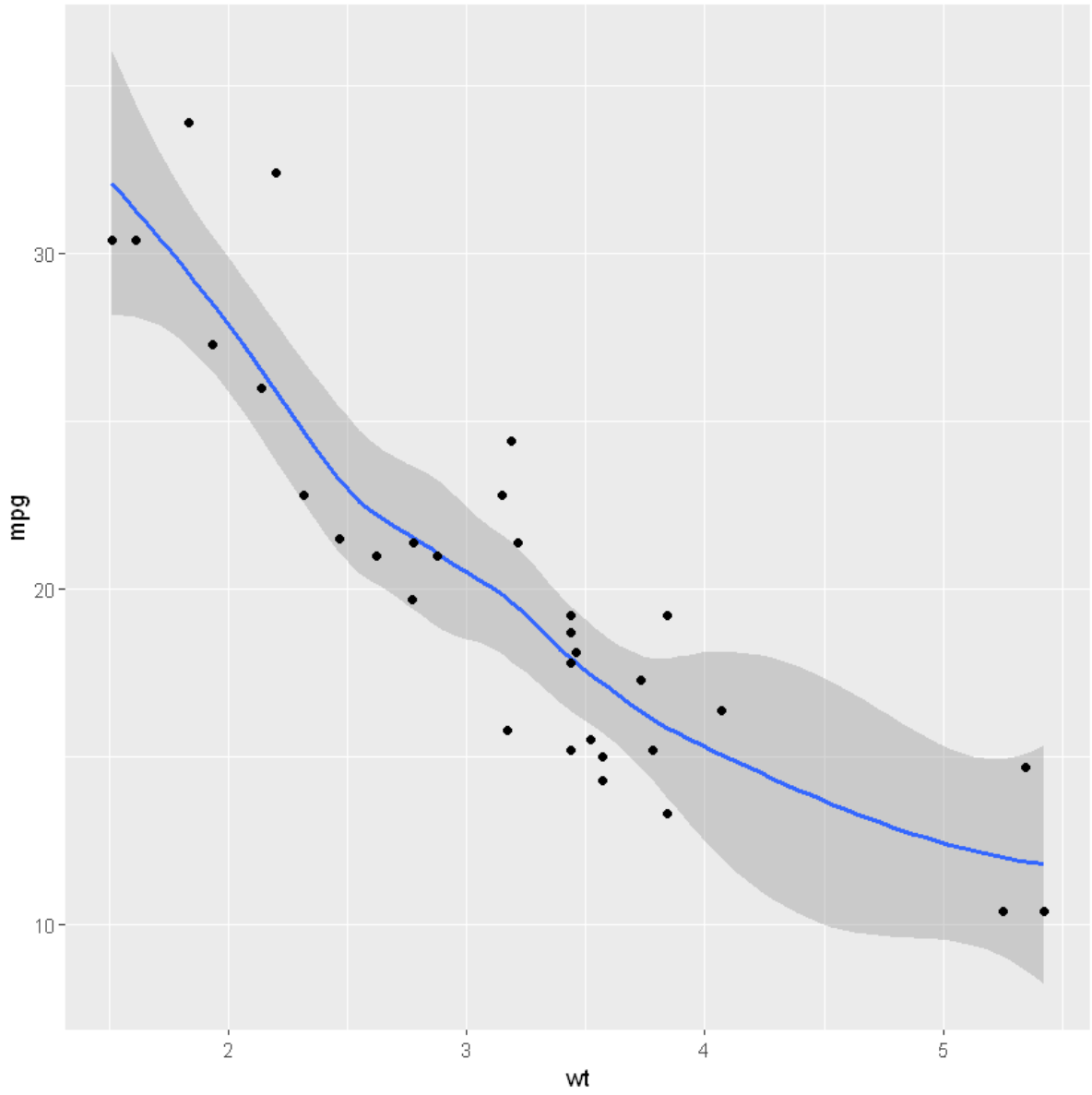


In [40]:
```
print(ggplot(mtcars, aes(x = disp ,y = mpg)) + stat_smooth()+ geom_point())
print(ggplot(mtcars, aes(x = wt ,y = mpg)) + stat_smooth()+ geom_point())
print(ggplot(mtcars, aes(x = vs ,y = mpg)) + stat_smooth()+ geom_point())
print(ggplot(mtcars, aes(x = hp ,y = mpg)) + stat_smooth()+ geom_point())
```

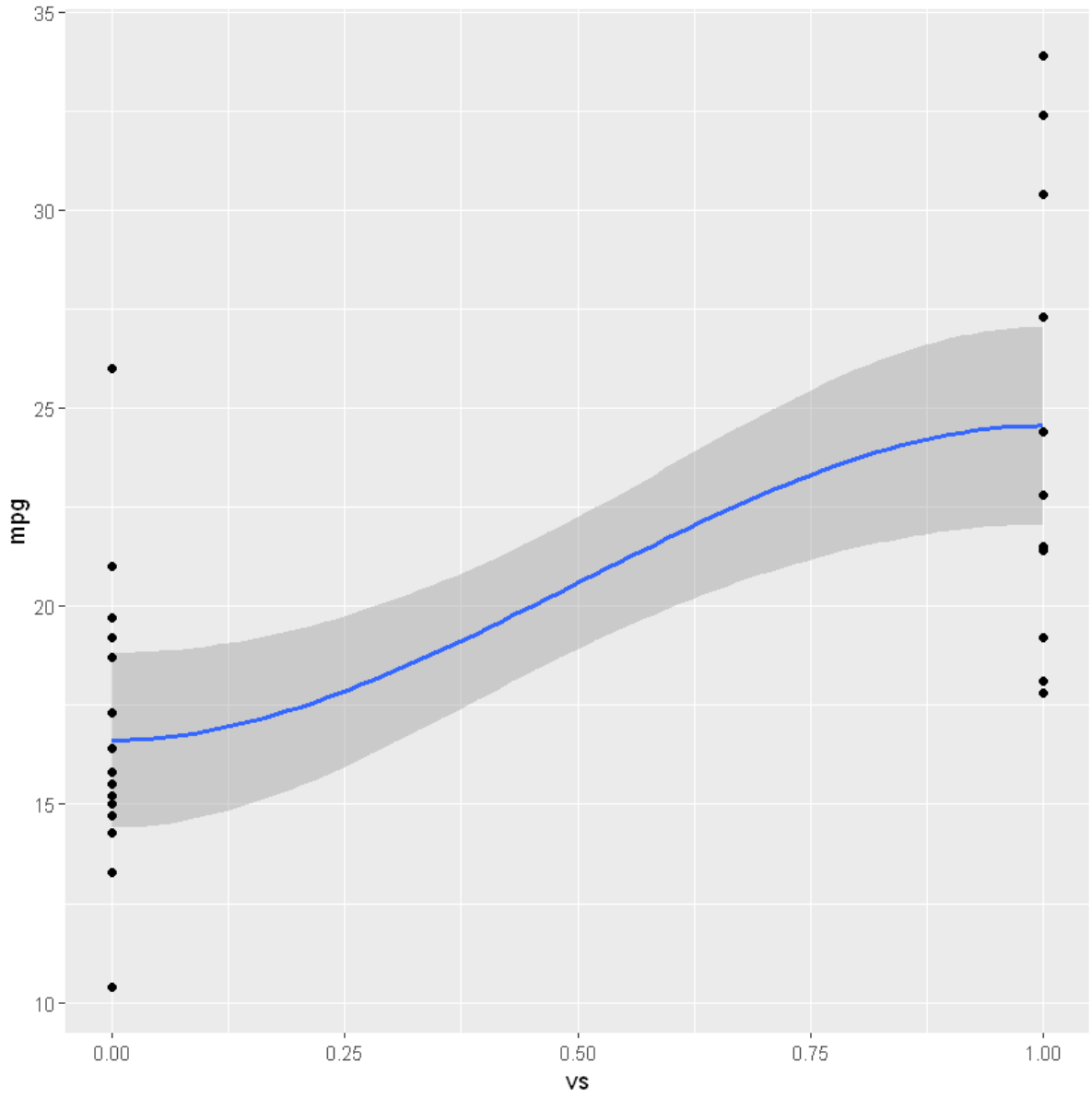
```
`geom_smooth()` using method = 'loess' and formula 'y ~ x'
`geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

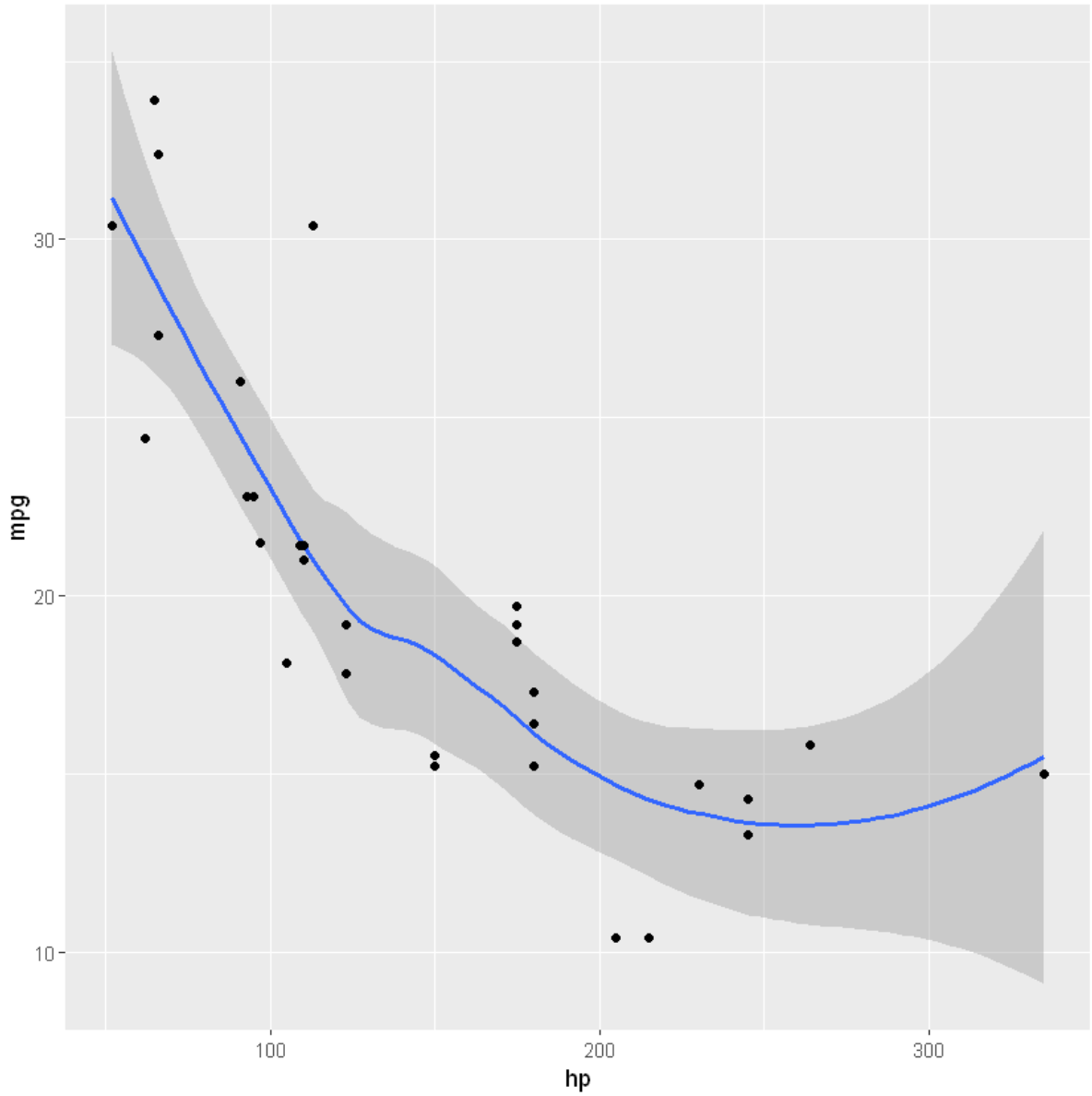



```
`geom_smooth()` using method = 'loess' and formula 'y ~ x'
Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"pseudoinverse used at -0.005"Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"neighborhood radius 1.005"Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"reciprocal condition number  0"Warning message in simpleLoess(y, x, w, span, degree = degree, parametric = parametric, :
"There are other near singularities as well. 1.01"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x e
lse if (is.data.frame(newdata)) as.matrix(model.frame(delete.response(terms(object)), :
"pseudoinverse used at -0.005"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x else if (is.data.fram
e(newdata)) as.matrix(model.frame(delete.response(terms(object)), :
"neighborhood radius 1.005"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x else if (is.data.frame(n
ewdata)) as.matrix(model.frame(delete.response(terms(object)), :
"reciprocal condition number  0"Warning message in predLoess(object$y, object$x, newx = if (is.null(newdata)) object$x else if (is.data.fr
ame(newdata)) as.matrix(model.frame(delete.response(terms(object)), :
"There are other near singularities as well. 1.01"
```




```
`geom_smooth()` using method = 'loess' and formula 'y ~ x'
```


35
30
25
20
15
10
mpg
0.00
0.25
0.50
0.75
1.00
vs



In [41]:
```
model1 = lm(mpg ~ disp + hp + wt+ vs, data = mtcars)
model1
```

```
Call:
lm(formula = mpg ~ disp + hp + wt + vs, data = mtcars)

Coefficients:
(Intercept)         disp           hp           wt           vs
  35.584987     0.002989    -0.026748    -4.015633     1.505746
```

In [42]:
```
summary(model1)
```

```
Call:
lm(formula = mpg ~ disp + hp + wt + vs, data = mtcars)

Residuals:
    Min      1Q  Median      3Q     Max 
-3.4879 -1.5042 -0.5028  1.0993  5.7040 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) 35.584987   2.577167  13.808 9.38e-14 ***
disp         0.002989   0.011025   0.271 0.788334    
hp          -0.026748   0.012206  -2.191 0.037228 *  
wt          -4.015633   1.085529  -3.699 0.000975 ***
vs           1.505746   1.467071   1.026 0.313829    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.636 on 27 degrees of freedom
Multiple R-squared:  0.8333,    Adjusted R-squared:  0.8086 
F-statistic: 33.75 on 4 and 27 DF,  p-value: 3.827e-10
```

In [43]:
```
plot(model1, pch = 16, which = 1 )
```