

Worksheet 6

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```
#Use the dataset mpg
```

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.2.2
```

```
#to get the mpg dataset, load the ggplot package first
```

```
data(mpg)
```

```
as.data.frame(data(mpg)) #converting from list to data frame
```

```
## data(mpg)
```

```
## 1 mpg
```

```
#use of glimpse() - much tidier compared to str()
```

```
library(dplyr) #glimpse() is a function under dplyr package
```

```
##
```

```
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
```

```
##
```

```
## filter, lag
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
## intersect, setdiff, setequal, union
```

```
mpgdata <- glimpse(mpg)
```

```
## Rows: 234
```

```
## Columns: 11
```

```
## $ manufacturer <chr> "audi", "audi", "audi", "audi", "audi", "audi", "audi", "~
```

```
## $ model <chr> "a4", "a4", "a4", "a4", "a4", "a4", "a4", "a4 quattro", "~
```

```
## $ displ <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
```

```
## $ year <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
```

```
## $ cyl <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
```

```
## $ trans <chr> "auto(l5)", "manual(m5)", "manual(m6)", "auto(av)", "auto~
```

```
## $ drv <chr> "f", "f", "f", "f", "f", "f", "f", "f", "4", "4", "4", "4", "4~
```

```
## $ cty <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
```

```
## $ hwy <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
```

```
## $ fl <chr> "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p~
```

```
## $ class <chr> "compact", "compact", "compact", "compact", "compact", "c~
```

```
as.data.frame(mpgdata)
```

##	manufacturer	model	displ	year	cyl	trans	drv	cty	hwy
## 1	audi	a4	1.8	1999	4	auto(l5)	f	18	29
## 2	audi	a4	1.8	1999	4	manual(m5)	f	21	29
## 3	audi	a4	2.0	2008	4	manual(m6)	f	20	31
## 4	audi	a4	2.0	2008	4	auto(av)	f	21	30
## 5	audi	a4	2.8	1999	6	auto(l5)	f	16	26
## 6	audi	a4	2.8	1999	6	manual(m5)	f	18	26
## 7	audi	a4	3.1	2008	6	auto(av)	f	18	27
## 8	audi	a4 quattro	1.8	1999	4	manual(m5)	4	18	26
## 9	audi	a4 quattro	1.8	1999	4	auto(l5)	4	16	25
## 10	audi	a4 quattro	2.0	2008	4	manual(m6)	4	20	28
## 11	audi	a4 quattro	2.0	2008	4	auto(s6)	4	19	27
## 12	audi	a4 quattro	2.8	1999	6	auto(l5)	4	15	25
## 13	audi	a4 quattro	2.8	1999	6	manual(m5)	4	17	25
## 14	audi	a4 quattro	3.1	2008	6	auto(s6)	4	17	25
## 15	audi	a4 quattro	3.1	2008	6	manual(m6)	4	15	25
## 16	audi	a6 quattro	2.8	1999	6	auto(l5)	4	15	24
## 17	audi	a6 quattro	3.1	2008	6	auto(s6)	4	17	25
## 18	audi	a6 quattro	4.2	2008	8	auto(s6)	4	16	23
## 19	chevrolet	c1500 suburban 2wd	5.3	2008	8	auto(l4)	r	14	20
## 20	chevrolet	c1500 suburban 2wd	5.3	2008	8	auto(l4)	r	11	15
## 21	chevrolet	c1500 suburban 2wd	5.3	2008	8	auto(l4)	r	14	20
## 22	chevrolet	c1500 suburban 2wd	5.7	1999	8	auto(l4)	r	13	17
## 23	chevrolet	c1500 suburban 2wd	6.0	2008	8	auto(l4)	r	12	17
## 24	chevrolet	corvette	5.7	1999	8	manual(m6)	r	16	26
## 25	chevrolet	corvette	5.7	1999	8	auto(l4)	r	15	23
## 26	chevrolet	corvette	6.2	2008	8	manual(m6)	r	16	26
## 27	chevrolet	corvette	6.2	2008	8	auto(s6)	r	15	25
## 28	chevrolet	corvette	7.0	2008	8	manual(m6)	r	15	24
## 29	chevrolet	k1500 tahoe 4wd	5.3	2008	8	auto(l4)	4	14	19
## 30	chevrolet	k1500 tahoe 4wd	5.3	2008	8	auto(l4)	4	11	14
## 31	chevrolet	k1500 tahoe 4wd	5.7	1999	8	auto(l4)	4	11	15
## 32	chevrolet	k1500 tahoe 4wd	6.5	1999	8	auto(l4)	4	14	17
## 33	chevrolet	malibu	2.4	1999	4	auto(l4)	f	19	27
## 34	chevrolet	malibu	2.4	2008	4	auto(l4)	f	22	30
## 35	chevrolet	malibu	3.1	1999	6	auto(l4)	f	18	26
## 36	chevrolet	malibu	3.5	2008	6	auto(l4)	f	18	29
## 37	chevrolet	malibu	3.6	2008	6	auto(s6)	f	17	26
## 38	dodge	caravan 2wd	2.4	1999	4	auto(l3)	f	18	24
## 39	dodge	caravan 2wd	3.0	1999	6	auto(l4)	f	17	24
## 40	dodge	caravan 2wd	3.3	1999	6	auto(l4)	f	16	22
## 41	dodge	caravan 2wd	3.3	1999	6	auto(l4)	f	16	22
## 42	dodge	caravan 2wd	3.3	2008	6	auto(l4)	f	17	24
## 43	dodge	caravan 2wd	3.3	2008	6	auto(l4)	f	17	24
## 44	dodge	caravan 2wd	3.3	2008	6	auto(l4)	f	11	17
## 45	dodge	caravan 2wd	3.8	1999	6	auto(l4)	f	15	22
## 46	dodge	caravan 2wd	3.8	1999	6	auto(l4)	f	15	21
## 47	dodge	caravan 2wd	3.8	2008	6	auto(l6)	f	16	23
## 48	dodge	caravan 2wd	4.0	2008	6	auto(l6)	f	16	23
## 49	dodge	dakota pickup 4wd	3.7	2008	6	manual(m6)	4	15	19
## 50	dodge	dakota pickup 4wd	3.7	2008	6	auto(l4)	4	14	18

## 51	dodge	dakota pickup 4wd	3.9	1999	6	auto(14)	4	13	17
## 52	dodge	dakota pickup 4wd	3.9	1999	6	manual(m5)	4	14	17
## 53	dodge	dakota pickup 4wd	4.7	2008	8	auto(15)	4	14	19
## 54	dodge	dakota pickup 4wd	4.7	2008	8	auto(15)	4	14	19
## 55	dodge	dakota pickup 4wd	4.7	2008	8	auto(15)	4	9	12
## 56	dodge	dakota pickup 4wd	5.2	1999	8	manual(m5)	4	11	17
## 57	dodge	dakota pickup 4wd	5.2	1999	8	auto(14)	4	11	15
## 58	dodge	durango 4wd	3.9	1999	6	auto(14)	4	13	17
## 59	dodge	durango 4wd	4.7	2008	8	auto(15)	4	13	17
## 60	dodge	durango 4wd	4.7	2008	8	auto(15)	4	9	12
## 61	dodge	durango 4wd	4.7	2008	8	auto(15)	4	13	17
## 62	dodge	durango 4wd	5.2	1999	8	auto(14)	4	11	16
## 63	dodge	durango 4wd	5.7	2008	8	auto(15)	4	13	18
## 64	dodge	durango 4wd	5.9	1999	8	auto(14)	4	11	15
## 65	dodge	ram 1500 pickup 4wd	4.7	2008	8	manual(m6)	4	12	16
## 66	dodge	ram 1500 pickup 4wd	4.7	2008	8	auto(15)	4	9	12
## 67	dodge	ram 1500 pickup 4wd	4.7	2008	8	auto(15)	4	13	17
## 68	dodge	ram 1500 pickup 4wd	4.7	2008	8	auto(15)	4	13	17
## 69	dodge	ram 1500 pickup 4wd	4.7	2008	8	manual(m6)	4	12	16
## 70	dodge	ram 1500 pickup 4wd	4.7	2008	8	manual(m6)	4	9	12
## 71	dodge	ram 1500 pickup 4wd	5.2	1999	8	auto(14)	4	11	15
## 72	dodge	ram 1500 pickup 4wd	5.2	1999	8	manual(m5)	4	11	16
## 73	dodge	ram 1500 pickup 4wd	5.7	2008	8	auto(15)	4	13	17
## 74	dodge	ram 1500 pickup 4wd	5.9	1999	8	auto(14)	4	11	15
## 75	ford	expedition 2wd	4.6	1999	8	auto(14)	r	11	17
## 76	ford	expedition 2wd	5.4	1999	8	auto(14)	r	11	17
## 77	ford	expedition 2wd	5.4	2008	8	auto(16)	r	12	18
## 78	ford	explorer 4wd	4.0	1999	6	auto(15)	4	14	17
## 79	ford	explorer 4wd	4.0	1999	6	manual(m5)	4	15	19
## 80	ford	explorer 4wd	4.0	1999	6	auto(15)	4	14	17
## 81	ford	explorer 4wd	4.0	2008	6	auto(15)	4	13	19
## 82	ford	explorer 4wd	4.6	2008	8	auto(16)	4	13	19
## 83	ford	explorer 4wd	5.0	1999	8	auto(14)	4	13	17
## 84	ford	f150 pickup 4wd	4.2	1999	6	auto(14)	4	14	17
## 85	ford	f150 pickup 4wd	4.2	1999	6	manual(m5)	4	14	17
## 86	ford	f150 pickup 4wd	4.6	1999	8	manual(m5)	4	13	16
## 87	ford	f150 pickup 4wd	4.6	1999	8	auto(14)	4	13	16
## 88	ford	f150 pickup 4wd	4.6	2008	8	auto(14)	4	13	17
## 89	ford	f150 pickup 4wd	5.4	1999	8	auto(14)	4	11	15
## 90	ford	f150 pickup 4wd	5.4	2008	8	auto(14)	4	13	17
## 91	ford	mustang	3.8	1999	6	manual(m5)	r	18	26
## 92	ford	mustang	3.8	1999	6	auto(14)	r	18	25
## 93	ford	mustang	4.0	2008	6	manual(m5)	r	17	26
## 94	ford	mustang	4.0	2008	6	auto(15)	r	16	24
## 95	ford	mustang	4.6	1999	8	auto(14)	r	15	21
## 96	ford	mustang	4.6	1999	8	manual(m5)	r	15	22
## 97	ford	mustang	4.6	2008	8	manual(m5)	r	15	23
## 98	ford	mustang	4.6	2008	8	auto(15)	r	15	22
## 99	ford	mustang	5.4	2008	8	manual(m6)	r	14	20
## 100	honda	civic	1.6	1999	4	manual(m5)	f	28	33
## 101	honda	civic	1.6	1999	4	auto(14)	f	24	32
## 102	honda	civic	1.6	1999	4	manual(m5)	f	25	32
## 103	honda	civic	1.6	1999	4	manual(m5)	f	23	29
## 104	honda	civic	1.6	1999	4	auto(14)	f	24	32

## 105	honda	civic	1.8	2008	4	manual(m5)	f	26	34
## 106	honda	civic	1.8	2008	4	auto(15)	f	25	36
## 107	honda	civic	1.8	2008	4	auto(15)	f	24	36
## 108	honda	civic	2.0	2008	4	manual(m6)	f	21	29
## 109	hyundai	sonata	2.4	1999	4	auto(14)	f	18	26
## 110	hyundai	sonata	2.4	1999	4	manual(m5)	f	18	27
## 111	hyundai	sonata	2.4	2008	4	auto(14)	f	21	30
## 112	hyundai	sonata	2.4	2008	4	manual(m5)	f	21	31
## 113	hyundai	sonata	2.5	1999	6	auto(14)	f	18	26
## 114	hyundai	sonata	2.5	1999	6	manual(m5)	f	18	26
## 115	hyundai	sonata	3.3	2008	6	auto(15)	f	19	28
## 116	hyundai	tiburon	2.0	1999	4	auto(14)	f	19	26
## 117	hyundai	tiburon	2.0	1999	4	manual(m5)	f	19	29
## 118	hyundai	tiburon	2.0	2008	4	manual(m5)	f	20	28
## 119	hyundai	tiburon	2.0	2008	4	auto(14)	f	20	27
## 120	hyundai	tiburon	2.7	2008	6	auto(14)	f	17	24
## 121	hyundai	tiburon	2.7	2008	6	manual(m6)	f	16	24
## 122	hyundai	tiburon	2.7	2008	6	manual(m5)	f	17	24
## 123	jeep	grand cherokee 4wd	3.0	2008	6	auto(15)	4	17	22
## 124	jeep	grand cherokee 4wd	3.7	2008	6	auto(15)	4	15	19
## 125	jeep	grand cherokee 4wd	4.0	1999	6	auto(14)	4	15	20
## 126	jeep	grand cherokee 4wd	4.7	1999	8	auto(14)	4	14	17
## 127	jeep	grand cherokee 4wd	4.7	2008	8	auto(15)	4	9	12
## 128	jeep	grand cherokee 4wd	4.7	2008	8	auto(15)	4	14	19
## 129	jeep	grand cherokee 4wd	5.7	2008	8	auto(15)	4	13	18
## 130	jeep	grand cherokee 4wd	6.1	2008	8	auto(15)	4	11	14
## 131	land rover	range rover	4.0	1999	8	auto(14)	4	11	15
## 132	land rover	range rover	4.2	2008	8	auto(s6)	4	12	18
## 133	land rover	range rover	4.4	2008	8	auto(s6)	4	12	18
## 134	land rover	range rover	4.6	1999	8	auto(14)	4	11	15
## 135	lincoln	navigator 2wd	5.4	1999	8	auto(14)	r	11	17
## 136	lincoln	navigator 2wd	5.4	1999	8	auto(14)	r	11	16
## 137	lincoln	navigator 2wd	5.4	2008	8	auto(16)	r	12	18
## 138	mercury	mountaineer 4wd	4.0	1999	6	auto(15)	4	14	17
## 139	mercury	mountaineer 4wd	4.0	2008	6	auto(15)	4	13	19
## 140	mercury	mountaineer 4wd	4.6	2008	8	auto(16)	4	13	19
## 141	mercury	mountaineer 4wd	5.0	1999	8	auto(14)	4	13	17
## 142	nissan	altima	2.4	1999	4	manual(m5)	f	21	29
## 143	nissan	altima	2.4	1999	4	auto(14)	f	19	27
## 144	nissan	altima	2.5	2008	4	auto(av)	f	23	31
## 145	nissan	altima	2.5	2008	4	manual(m6)	f	23	32
## 146	nissan	altima	3.5	2008	6	manual(m6)	f	19	27
## 147	nissan	altima	3.5	2008	6	auto(av)	f	19	26
## 148	nissan	maxima	3.0	1999	6	auto(14)	f	18	26
## 149	nissan	maxima	3.0	1999	6	manual(m5)	f	19	25
## 150	nissan	maxima	3.5	2008	6	auto(av)	f	19	25
## 151	nissan	pathfinder 4wd	3.3	1999	6	auto(14)	4	14	17
## 152	nissan	pathfinder 4wd	3.3	1999	6	manual(m5)	4	15	17
## 153	nissan	pathfinder 4wd	4.0	2008	6	auto(15)	4	14	20
## 154	nissan	pathfinder 4wd	5.6	2008	8	auto(s5)	4	12	18
## 155	pontiac	grand prix	3.1	1999	6	auto(14)	f	18	26
## 156	pontiac	grand prix	3.8	1999	6	auto(14)	f	16	26
## 157	pontiac	grand prix	3.8	1999	6	auto(14)	f	17	27
## 158	pontiac	grand prix	3.8	2008	6	auto(14)	f	18	28

## 159	pontiac	grand prix	5.3	2008	8	auto(s4)	f	16	25
## 160	subaru	forester awd	2.5	1999	4	manual(m5)	4	18	25
## 161	subaru	forester awd	2.5	1999	4	auto(l4)	4	18	24
## 162	subaru	forester awd	2.5	2008	4	manual(m5)	4	20	27
## 163	subaru	forester awd	2.5	2008	4	manual(m5)	4	19	25
## 164	subaru	forester awd	2.5	2008	4	auto(l4)	4	20	26
## 165	subaru	forester awd	2.5	2008	4	auto(l4)	4	18	23
## 166	subaru	impreza awd	2.2	1999	4	auto(l4)	4	21	26
## 167	subaru	impreza awd	2.2	1999	4	manual(m5)	4	19	26
## 168	subaru	impreza awd	2.5	1999	4	manual(m5)	4	19	26
## 169	subaru	impreza awd	2.5	1999	4	auto(l4)	4	19	26
## 170	subaru	impreza awd	2.5	2008	4	auto(s4)	4	20	25
## 171	subaru	impreza awd	2.5	2008	4	auto(s4)	4	20	27
## 172	subaru	impreza awd	2.5	2008	4	manual(m5)	4	19	25
## 173	subaru	impreza awd	2.5	2008	4	manual(m5)	4	20	27
## 174	toyota	4runner 4wd	2.7	1999	4	manual(m5)	4	15	20
## 175	toyota	4runner 4wd	2.7	1999	4	auto(l4)	4	16	20
## 176	toyota	4runner 4wd	3.4	1999	6	auto(l4)	4	15	19
## 177	toyota	4runner 4wd	3.4	1999	6	manual(m5)	4	15	17
## 178	toyota	4runner 4wd	4.0	2008	6	auto(l5)	4	16	20
## 179	toyota	4runner 4wd	4.7	2008	8	auto(l5)	4	14	17
## 180	toyota	camry	2.2	1999	4	manual(m5)	f	21	29
## 181	toyota	camry	2.2	1999	4	auto(l4)	f	21	27
## 182	toyota	camry	2.4	2008	4	manual(m5)	f	21	31
## 183	toyota	camry	2.4	2008	4	auto(l5)	f	21	31
## 184	toyota	camry	3.0	1999	6	auto(l4)	f	18	26
## 185	toyota	camry	3.0	1999	6	manual(m5)	f	18	26
## 186	toyota	camry	3.5	2008	6	auto(s6)	f	19	28
## 187	toyota	camry solara	2.2	1999	4	auto(l4)	f	21	27
## 188	toyota	camry solara	2.2	1999	4	manual(m5)	f	21	29
## 189	toyota	camry solara	2.4	2008	4	manual(m5)	f	21	31
## 190	toyota	camry solara	2.4	2008	4	auto(s5)	f	22	31
## 191	toyota	camry solara	3.0	1999	6	auto(l4)	f	18	26
## 192	toyota	camry solara	3.0	1999	6	manual(m5)	f	18	26
## 193	toyota	camry solara	3.3	2008	6	auto(s5)	f	18	27
## 194	toyota	corolla	1.8	1999	4	auto(l3)	f	24	30
## 195	toyota	corolla	1.8	1999	4	auto(l4)	f	24	33
## 196	toyota	corolla	1.8	1999	4	manual(m5)	f	26	35
## 197	toyota	corolla	1.8	2008	4	manual(m5)	f	28	37
## 198	toyota	corolla	1.8	2008	4	auto(l4)	f	26	35
## 199	toyota	land cruiser wagon 4wd	4.7	1999	8	auto(l4)	4	11	15
## 200	toyota	land cruiser wagon 4wd	5.7	2008	8	auto(s6)	4	13	18
## 201	toyota	toyota tacoma 4wd	2.7	1999	4	manual(m5)	4	15	20
## 202	toyota	toyota tacoma 4wd	2.7	1999	4	auto(l4)	4	16	20
## 203	toyota	toyota tacoma 4wd	2.7	2008	4	manual(m5)	4	17	22
## 204	toyota	toyota tacoma 4wd	3.4	1999	6	manual(m5)	4	15	17
## 205	toyota	toyota tacoma 4wd	3.4	1999	6	auto(l4)	4	15	19
## 206	toyota	toyota tacoma 4wd	4.0	2008	6	manual(m6)	4	15	18
## 207	toyota	toyota tacoma 4wd	4.0	2008	6	auto(l5)	4	16	20
## 208	volkswagen	gti	2.0	1999	4	manual(m5)	f	21	29
## 209	volkswagen	gti	2.0	1999	4	auto(l4)	f	19	26
## 210	volkswagen	gti	2.0	2008	4	manual(m6)	f	21	29
## 211	volkswagen	gti	2.0	2008	4	auto(s6)	f	22	29
## 212	volkswagen	gti	2.8	1999	6	manual(m5)	f	17	24

## 213	volkswagen	jetta	1.9	1999	4	manual(m5)	f	33	44
## 214	volkswagen	jetta	2.0	1999	4	manual(m5)	f	21	29
## 215	volkswagen	jetta	2.0	1999	4	auto(l4)	f	19	26
## 216	volkswagen	jetta	2.0	2008	4	auto(s6)	f	22	29
## 217	volkswagen	jetta	2.0	2008	4	manual(m6)	f	21	29
## 218	volkswagen	jetta	2.5	2008	5	auto(s6)	f	21	29
## 219	volkswagen	jetta	2.5	2008	5	manual(m5)	f	21	29
## 220	volkswagen	jetta	2.8	1999	6	auto(l4)	f	16	23
## 221	volkswagen	jetta	2.8	1999	6	manual(m5)	f	17	24
## 222	volkswagen	new beetle	1.9	1999	4	manual(m5)	f	35	44
## 223	volkswagen	new beetle	1.9	1999	4	auto(l4)	f	29	41
## 224	volkswagen	new beetle	2.0	1999	4	manual(m5)	f	21	29
## 225	volkswagen	new beetle	2.0	1999	4	auto(l4)	f	19	26
## 226	volkswagen	new beetle	2.5	2008	5	manual(m5)	f	20	28
## 227	volkswagen	new beetle	2.5	2008	5	auto(s6)	f	20	29
## 228	volkswagen	passat	1.8	1999	4	manual(m5)	f	21	29
## 229	volkswagen	passat	1.8	1999	4	auto(l5)	f	18	29
## 230	volkswagen	passat	2.0	2008	4	auto(s6)	f	19	28
## 231	volkswagen	passat	2.0	2008	4	manual(m6)	f	21	29
## 232	volkswagen	passat	2.8	1999	6	auto(l5)	f	16	26
## 233	volkswagen	passat	2.8	1999	6	manual(m5)	f	18	26
## 234	volkswagen	passat	3.6	2008	6	auto(s6)	f	17	26
##	fl	class							
## 1	p	compact							
## 2	p	compact							
## 3	p	compact							
## 4	p	compact							
## 5	p	compact							
## 6	p	compact							
## 7	p	compact							
## 8	p	compact							
## 9	p	compact							
## 10	p	compact							
## 11	p	compact							
## 12	p	compact							
## 13	p	compact							
## 14	p	compact							
## 15	p	compact							
## 16	p	midsize							
## 17	p	midsize							
## 18	p	midsize							
## 19	r	suv							
## 20	e	suv							
## 21	r	suv							
## 22	r	suv							
## 23	r	suv							
## 24	p	2seater							
## 25	p	2seater							
## 26	p	2seater							
## 27	p	2seater							
## 28	p	2seater							
## 29	r	suv							
## 30	e	suv							
## 31	r	suv							

## 32	d	suv
## 33	r	midsize
## 34	r	midsize
## 35	r	midsize
## 36	r	midsize
## 37	r	midsize
## 38	r	minivan
## 39	r	minivan
## 40	r	minivan
## 41	r	minivan
## 42	r	minivan
## 43	r	minivan
## 44	e	minivan
## 45	r	minivan
## 46	r	minivan
## 47	r	minivan
## 48	r	minivan
## 49	r	pickup
## 50	r	pickup
## 51	r	pickup
## 52	r	pickup
## 53	r	pickup
## 54	r	pickup
## 55	e	pickup
## 56	r	pickup
## 57	r	pickup
## 58	r	suv
## 59	r	suv
## 60	e	suv
## 61	r	suv
## 62	r	suv
## 63	r	suv
## 64	r	suv
## 65	r	pickup
## 66	e	pickup
## 67	r	pickup
## 68	r	pickup
## 69	r	pickup
## 70	e	pickup
## 71	r	pickup
## 72	r	pickup
## 73	r	pickup
## 74	r	pickup
## 75	r	suv
## 76	r	suv
## 77	r	suv
## 78	r	suv
## 79	r	suv
## 80	r	suv
## 81	r	suv
## 82	r	suv
## 83	r	suv
## 84	r	pickup
## 85	r	pickup

86 r pickup
87 r pickup
88 r pickup
89 r pickup
90 r pickup
91 r subcompact
92 r subcompact
93 r subcompact
94 r subcompact
95 r subcompact
96 r subcompact
97 r subcompact
98 r subcompact
99 p subcompact
100 r subcompact
101 r subcompact
102 r subcompact
103 p subcompact
104 r subcompact
105 r subcompact
106 r subcompact
107 c subcompact
108 p subcompact
109 r midsize
110 r midsize
111 r midsize
112 r midsize
113 r midsize
114 r midsize
115 r midsize
116 r subcompact
117 r subcompact
118 r subcompact
119 r subcompact
120 r subcompact
121 r subcompact
122 r subcompact
123 d suv
124 r suv
125 r suv
126 r suv
127 e suv
128 r suv
129 r suv
130 p suv
131 p suv
132 r suv
133 r suv
134 p suv
135 r suv
136 p suv
137 r suv
138 r suv
139 r suv

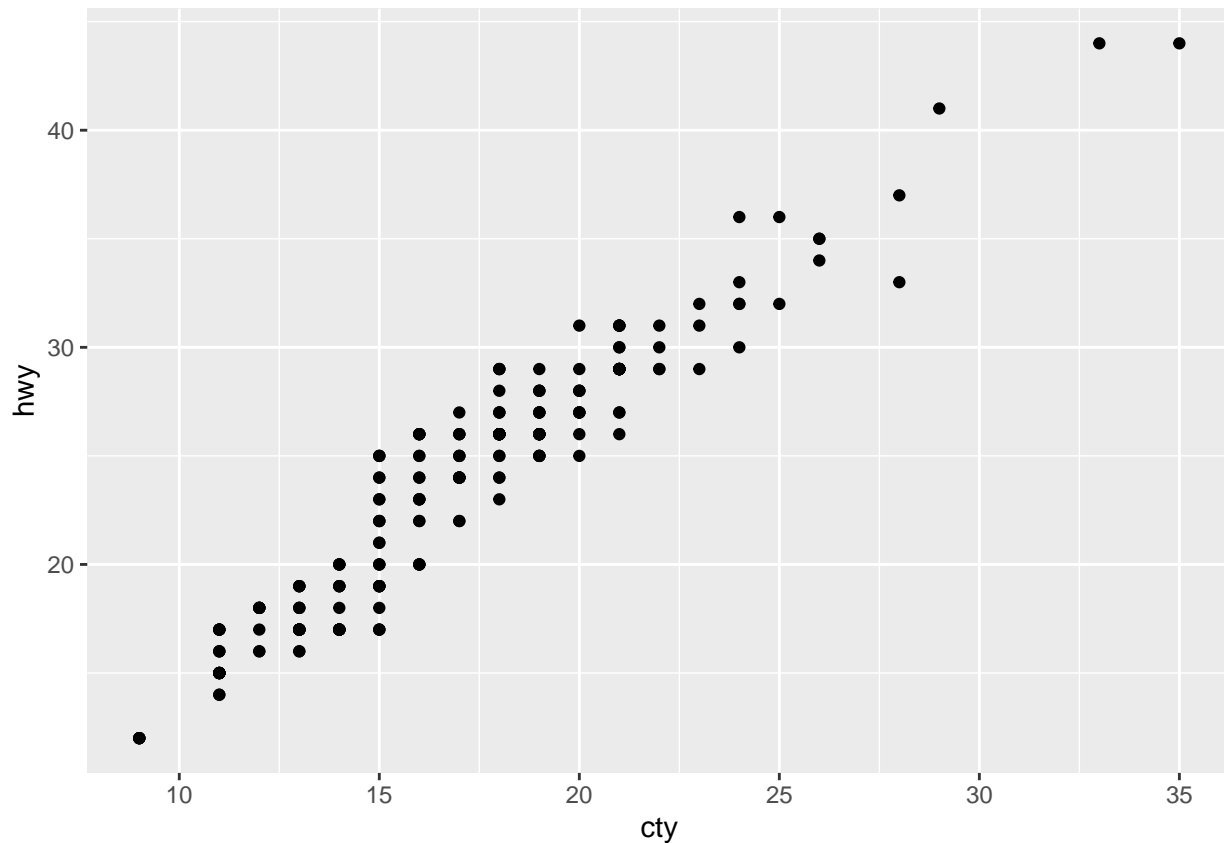

```

## 140 r      suv
## 141 r      suv
## 142 r    compact
## 143 r    compact
## 144 r   midsize
## 145 r   midsize
## 146 p   midsize
## 147 p   midsize
## 148 r   midsize
## 149 r   midsize
## 150 p   midsize
## 151 r      suv
## 152 r      suv
## 153 p      suv
## 154 p      suv
## 155 r   midsize
## 156 p   midsize
## 157 r   midsize
## 158 r   midsize
## 159 p   midsize
## 160 r      suv
## 161 r      suv
## 162 r      suv
## 163 p      suv
## 164 r      suv
## 165 p      suv
## 166 r subcompact
## 167 r subcompact
## 168 r subcompact
## 169 r subcompact
## 170 p    compact
## 171 r    compact
## 172 p    compact
## 173 r    compact
## 174 r      suv
## 175 r      suv
## 176 r      suv
## 177 r      suv
## 178 r      suv
## 179 r      suv
## 180 r   midsize
## 181 r   midsize
## 182 r   midsize
## 183 r   midsize
## 184 r   midsize
## 185 r   midsize
## 186 r   midsize
## 187 r    compact
## 188 r    compact
## 189 r    compact
## 190 r    compact
## 191 r    compact
## 192 r    compact
## 193 r    compact

```

```
## 194 r compact
## 195 r compact
## 196 r compact
## 197 r compact
## 198 r compact
## 199 r suv
## 200 r suv
## 201 r pickup
## 202 r pickup
## 203 r pickup
## 204 r pickup
## 205 r pickup
## 206 r pickup
## 207 r pickup
## 208 r compact
## 209 r compact
## 210 p compact
## 211 p compact
## 212 r compact
## 213 d compact
## 214 r compact
## 215 r compact
## 216 p compact
## 217 p compact
## 218 r compact
## 219 r compact
## 220 r compact
## 221 r compact
## 222 d subcompact
## 223 d subcompact
## 224 r subcompact
## 225 r subcompact
## 226 r subcompact
## 227 r subcompact
## 228 p midsize
## 229 p midsize
## 230 p midsize
## 231 p midsize
## 232 p midsize
## 233 p midsize
## 234 p midsize
```

```
#Example. graph using ggplot()
ggplot(mpg, aes(cty, hwy)) +
  geom_point()
```



*# 1. How many columns are in mpg dataset? How about the number of rows?
Show the codes and its result.*

There are 234 rows and 11 columns

#Code:

```
mpgdata <- glimpse(mpg)
```

```
## Rows: 234
## Columns: 11
## $ manufacturer <chr> "audi", "audi", "audi", "audi", "audi", "audi", "audi", "~
## $ model       <chr> "a4", "a4", "a4", "a4", "a4", "a4", "a4", "a4 quattro", "~
## $ displ      <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
## $ year       <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
## $ cyl        <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
## $ trans      <chr> "auto(l5)", "manual(m5)", "manual(m6)", "auto(av)", "auto~
## $ drv        <chr> "f", "f", "f", "f", "f", "f", "f", "f", "4", "4", "4", "4", "4~
## $ cty        <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
## $ hwy        <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
## $ fl         <chr> "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p~
## $ class      <chr> "compact", "compact", "compact", "compact", "compact", "compact", "c~
```

```
as.data.frame(mpgdata)
```

```
##      manufacturer      model displ year cyl    trans drv cty hwy
```

## 1	audi	a4	1.8 1999	4	auto(15)	f	18	29
## 2	audi	a4	1.8 1999	4	manual(m5)	f	21	29
## 3	audi	a4	2.0 2008	4	manual(m6)	f	20	31
## 4	audi	a4	2.0 2008	4	auto(av)	f	21	30
## 5	audi	a4	2.8 1999	6	auto(15)	f	16	26
## 6	audi	a4	2.8 1999	6	manual(m5)	f	18	26
## 7	audi	a4	3.1 2008	6	auto(av)	f	18	27
## 8	audi	a4 quattro	1.8 1999	4	manual(m5)	4	18	26
## 9	audi	a4 quattro	1.8 1999	4	auto(15)	4	16	25
## 10	audi	a4 quattro	2.0 2008	4	manual(m6)	4	20	28
## 11	audi	a4 quattro	2.0 2008	4	auto(s6)	4	19	27
## 12	audi	a4 quattro	2.8 1999	6	auto(15)	4	15	25
## 13	audi	a4 quattro	2.8 1999	6	manual(m5)	4	17	25
## 14	audi	a4 quattro	3.1 2008	6	auto(s6)	4	17	25
## 15	audi	a4 quattro	3.1 2008	6	manual(m6)	4	15	25
## 16	audi	a6 quattro	2.8 1999	6	auto(15)	4	15	24
## 17	audi	a6 quattro	3.1 2008	6	auto(s6)	4	17	25
## 18	audi	a6 quattro	4.2 2008	8	auto(s6)	4	16	23
## 19	chevrolet	c1500 suburban 2wd	5.3 2008	8	auto(14)	r	14	20
## 20	chevrolet	c1500 suburban 2wd	5.3 2008	8	auto(14)	r	11	15
## 21	chevrolet	c1500 suburban 2wd	5.3 2008	8	auto(14)	r	14	20
## 22	chevrolet	c1500 suburban 2wd	5.7 1999	8	auto(14)	r	13	17
## 23	chevrolet	c1500 suburban 2wd	6.0 2008	8	auto(14)	r	12	17
## 24	chevrolet	corvette	5.7 1999	8	manual(m6)	r	16	26
## 25	chevrolet	corvette	5.7 1999	8	auto(14)	r	15	23
## 26	chevrolet	corvette	6.2 2008	8	manual(m6)	r	16	26
## 27	chevrolet	corvette	6.2 2008	8	auto(s6)	r	15	25
## 28	chevrolet	corvette	7.0 2008	8	manual(m6)	r	15	24
## 29	chevrolet	k1500 tahoe 4wd	5.3 2008	8	auto(14)	4	14	19
## 30	chevrolet	k1500 tahoe 4wd	5.3 2008	8	auto(14)	4	11	14
## 31	chevrolet	k1500 tahoe 4wd	5.7 1999	8	auto(14)	4	11	15
## 32	chevrolet	k1500 tahoe 4wd	6.5 1999	8	auto(14)	4	14	17
## 33	chevrolet	malibu	2.4 1999	4	auto(14)	f	19	27
## 34	chevrolet	malibu	2.4 2008	4	auto(14)	f	22	30
## 35	chevrolet	malibu	3.1 1999	6	auto(14)	f	18	26
## 36	chevrolet	malibu	3.5 2008	6	auto(14)	f	18	29
## 37	chevrolet	malibu	3.6 2008	6	auto(s6)	f	17	26
## 38	dodge	caravan 2wd	2.4 1999	4	auto(13)	f	18	24
## 39	dodge	caravan 2wd	3.0 1999	6	auto(14)	f	17	24
## 40	dodge	caravan 2wd	3.3 1999	6	auto(14)	f	16	22
## 41	dodge	caravan 2wd	3.3 1999	6	auto(14)	f	16	22
## 42	dodge	caravan 2wd	3.3 2008	6	auto(14)	f	17	24
## 43	dodge	caravan 2wd	3.3 2008	6	auto(14)	f	17	24
## 44	dodge	caravan 2wd	3.3 2008	6	auto(14)	f	11	17
## 45	dodge	caravan 2wd	3.8 1999	6	auto(14)	f	15	22
## 46	dodge	caravan 2wd	3.8 1999	6	auto(14)	f	15	21
## 47	dodge	caravan 2wd	3.8 2008	6	auto(16)	f	16	23
## 48	dodge	caravan 2wd	4.0 2008	6	auto(16)	f	16	23
## 49	dodge	dakota pickup 4wd	3.7 2008	6	manual(m6)	4	15	19
## 50	dodge	dakota pickup 4wd	3.7 2008	6	auto(14)	4	14	18
## 51	dodge	dakota pickup 4wd	3.9 1999	6	auto(14)	4	13	17
## 52	dodge	dakota pickup 4wd	3.9 1999	6	manual(m5)	4	14	17
## 53	dodge	dakota pickup 4wd	4.7 2008	8	auto(15)	4	14	19
## 54	dodge	dakota pickup 4wd	4.7 2008	8	auto(15)	4	14	19

## 55	dodge	dakota pickup 4wd	4.7 2008	8	auto(15)	4	9	12
## 56	dodge	dakota pickup 4wd	5.2 1999	8	manual(m5)	4	11	17
## 57	dodge	dakota pickup 4wd	5.2 1999	8	auto(14)	4	11	15
## 58	dodge	durango 4wd	3.9 1999	6	auto(14)	4	13	17
## 59	dodge	durango 4wd	4.7 2008	8	auto(15)	4	13	17
## 60	dodge	durango 4wd	4.7 2008	8	auto(15)	4	9	12
## 61	dodge	durango 4wd	4.7 2008	8	auto(15)	4	13	17
## 62	dodge	durango 4wd	5.2 1999	8	auto(14)	4	11	16
## 63	dodge	durango 4wd	5.7 2008	8	auto(15)	4	13	18
## 64	dodge	durango 4wd	5.9 1999	8	auto(14)	4	11	15
## 65	dodge	ram 1500 pickup 4wd	4.7 2008	8	manual(m6)	4	12	16
## 66	dodge	ram 1500 pickup 4wd	4.7 2008	8	auto(15)	4	9	12
## 67	dodge	ram 1500 pickup 4wd	4.7 2008	8	auto(15)	4	13	17
## 68	dodge	ram 1500 pickup 4wd	4.7 2008	8	auto(15)	4	13	17
## 69	dodge	ram 1500 pickup 4wd	4.7 2008	8	manual(m6)	4	12	16
## 70	dodge	ram 1500 pickup 4wd	4.7 2008	8	manual(m6)	4	9	12
## 71	dodge	ram 1500 pickup 4wd	5.2 1999	8	auto(14)	4	11	15
## 72	dodge	ram 1500 pickup 4wd	5.2 1999	8	manual(m5)	4	11	16
## 73	dodge	ram 1500 pickup 4wd	5.7 2008	8	auto(15)	4	13	17
## 74	dodge	ram 1500 pickup 4wd	5.9 1999	8	auto(14)	4	11	15
## 75	ford	expedition 2wd	4.6 1999	8	auto(14)	r	11	17
## 76	ford	expedition 2wd	5.4 1999	8	auto(14)	r	11	17
## 77	ford	expedition 2wd	5.4 2008	8	auto(16)	r	12	18
## 78	ford	explorer 4wd	4.0 1999	6	auto(15)	4	14	17
## 79	ford	explorer 4wd	4.0 1999	6	manual(m5)	4	15	19
## 80	ford	explorer 4wd	4.0 1999	6	auto(15)	4	14	17
## 81	ford	explorer 4wd	4.0 2008	6	auto(15)	4	13	19
## 82	ford	explorer 4wd	4.6 2008	8	auto(16)	4	13	19
## 83	ford	explorer 4wd	5.0 1999	8	auto(14)	4	13	17
## 84	ford	f150 pickup 4wd	4.2 1999	6	auto(14)	4	14	17
## 85	ford	f150 pickup 4wd	4.2 1999	6	manual(m5)	4	14	17
## 86	ford	f150 pickup 4wd	4.6 1999	8	manual(m5)	4	13	16
## 87	ford	f150 pickup 4wd	4.6 1999	8	auto(14)	4	13	16
## 88	ford	f150 pickup 4wd	4.6 2008	8	auto(14)	4	13	17
## 89	ford	f150 pickup 4wd	5.4 1999	8	auto(14)	4	11	15
## 90	ford	f150 pickup 4wd	5.4 2008	8	auto(14)	4	13	17
## 91	ford	mustang	3.8 1999	6	manual(m5)	r	18	26
## 92	ford	mustang	3.8 1999	6	auto(14)	r	18	25
## 93	ford	mustang	4.0 2008	6	manual(m5)	r	17	26
## 94	ford	mustang	4.0 2008	6	auto(15)	r	16	24
## 95	ford	mustang	4.6 1999	8	auto(14)	r	15	21
## 96	ford	mustang	4.6 1999	8	manual(m5)	r	15	22
## 97	ford	mustang	4.6 2008	8	manual(m5)	r	15	23
## 98	ford	mustang	4.6 2008	8	auto(15)	r	15	22
## 99	ford	mustang	5.4 2008	8	manual(m6)	r	14	20
## 100	honda	civic	1.6 1999	4	manual(m5)	f	28	33
## 101	honda	civic	1.6 1999	4	auto(14)	f	24	32
## 102	honda	civic	1.6 1999	4	manual(m5)	f	25	32
## 103	honda	civic	1.6 1999	4	manual(m5)	f	23	29
## 104	honda	civic	1.6 1999	4	auto(14)	f	24	32
## 105	honda	civic	1.8 2008	4	manual(m5)	f	26	34
## 106	honda	civic	1.8 2008	4	auto(15)	f	25	36
## 107	honda	civic	1.8 2008	4	auto(15)	f	24	36
## 108	honda	civic	2.0 2008	4	manual(m6)	f	21	29

## 109	hyundai	sonata	2.4	1999	4	auto(14)	f	18	26
## 110	hyundai	sonata	2.4	1999	4	manual(m5)	f	18	27
## 111	hyundai	sonata	2.4	2008	4	auto(14)	f	21	30
## 112	hyundai	sonata	2.4	2008	4	manual(m5)	f	21	31
## 113	hyundai	sonata	2.5	1999	6	auto(14)	f	18	26
## 114	hyundai	sonata	2.5	1999	6	manual(m5)	f	18	26
## 115	hyundai	sonata	3.3	2008	6	auto(15)	f	19	28
## 116	hyundai	tiburon	2.0	1999	4	auto(14)	f	19	26
## 117	hyundai	tiburon	2.0	1999	4	manual(m5)	f	19	29
## 118	hyundai	tiburon	2.0	2008	4	manual(m5)	f	20	28
## 119	hyundai	tiburon	2.0	2008	4	auto(14)	f	20	27
## 120	hyundai	tiburon	2.7	2008	6	auto(14)	f	17	24
## 121	hyundai	tiburon	2.7	2008	6	manual(m6)	f	16	24
## 122	hyundai	tiburon	2.7	2008	6	manual(m5)	f	17	24
## 123	jeep	grand cherokee 4wd	3.0	2008	6	auto(15)	4	17	22
## 124	jeep	grand cherokee 4wd	3.7	2008	6	auto(15)	4	15	19
## 125	jeep	grand cherokee 4wd	4.0	1999	6	auto(14)	4	15	20
## 126	jeep	grand cherokee 4wd	4.7	1999	8	auto(14)	4	14	17
## 127	jeep	grand cherokee 4wd	4.7	2008	8	auto(15)	4	9	12
## 128	jeep	grand cherokee 4wd	4.7	2008	8	auto(15)	4	14	19
## 129	jeep	grand cherokee 4wd	5.7	2008	8	auto(15)	4	13	18
## 130	jeep	grand cherokee 4wd	6.1	2008	8	auto(15)	4	11	14
## 131	land rover	range rover	4.0	1999	8	auto(14)	4	11	15
## 132	land rover	range rover	4.2	2008	8	auto(s6)	4	12	18
## 133	land rover	range rover	4.4	2008	8	auto(s6)	4	12	18
## 134	land rover	range rover	4.6	1999	8	auto(14)	4	11	15
## 135	lincoln	navigator 2wd	5.4	1999	8	auto(14)	r	11	17
## 136	lincoln	navigator 2wd	5.4	1999	8	auto(14)	r	11	16
## 137	lincoln	navigator 2wd	5.4	2008	8	auto(16)	r	12	18
## 138	mercury	mountaineer 4wd	4.0	1999	6	auto(15)	4	14	17
## 139	mercury	mountaineer 4wd	4.0	2008	6	auto(15)	4	13	19
## 140	mercury	mountaineer 4wd	4.6	2008	8	auto(16)	4	13	19
## 141	mercury	mountaineer 4wd	5.0	1999	8	auto(14)	4	13	17
## 142	nissan	altima	2.4	1999	4	manual(m5)	f	21	29
## 143	nissan	altima	2.4	1999	4	auto(14)	f	19	27
## 144	nissan	altima	2.5	2008	4	auto(av)	f	23	31
## 145	nissan	altima	2.5	2008	4	manual(m6)	f	23	32
## 146	nissan	altima	3.5	2008	6	manual(m6)	f	19	27
## 147	nissan	altima	3.5	2008	6	auto(av)	f	19	26
## 148	nissan	maxima	3.0	1999	6	auto(14)	f	18	26
## 149	nissan	maxima	3.0	1999	6	manual(m5)	f	19	25
## 150	nissan	maxima	3.5	2008	6	auto(av)	f	19	25
## 151	nissan	pathfinder 4wd	3.3	1999	6	auto(14)	4	14	17
## 152	nissan	pathfinder 4wd	3.3	1999	6	manual(m5)	4	15	17
## 153	nissan	pathfinder 4wd	4.0	2008	6	auto(15)	4	14	20
## 154	nissan	pathfinder 4wd	5.6	2008	8	auto(s5)	4	12	18
## 155	pontiac	grand prix	3.1	1999	6	auto(14)	f	18	26
## 156	pontiac	grand prix	3.8	1999	6	auto(14)	f	16	26
## 157	pontiac	grand prix	3.8	1999	6	auto(14)	f	17	27
## 158	pontiac	grand prix	3.8	2008	6	auto(14)	f	18	28
## 159	pontiac	grand prix	5.3	2008	8	auto(s4)	f	16	25
## 160	subaru	forester awd	2.5	1999	4	manual(m5)	4	18	25
## 161	subaru	forester awd	2.5	1999	4	auto(14)	4	18	24
## 162	subaru	forester awd	2.5	2008	4	manual(m5)	4	20	27

## 163	subaru	forester awd	2.5	2008	4 manual(m5)	4	19	25
## 164	subaru	forester awd	2.5	2008	4 auto(l4)	4	20	26
## 165	subaru	forester awd	2.5	2008	4 auto(l4)	4	18	23
## 166	subaru	impreza awd	2.2	1999	4 auto(l4)	4	21	26
## 167	subaru	impreza awd	2.2	1999	4 manual(m5)	4	19	26
## 168	subaru	impreza awd	2.5	1999	4 manual(m5)	4	19	26
## 169	subaru	impreza awd	2.5	1999	4 auto(l4)	4	19	26
## 170	subaru	impreza awd	2.5	2008	4 auto(s4)	4	20	25
## 171	subaru	impreza awd	2.5	2008	4 auto(s4)	4	20	27
## 172	subaru	impreza awd	2.5	2008	4 manual(m5)	4	19	25
## 173	subaru	impreza awd	2.5	2008	4 manual(m5)	4	20	27
## 174	toyota	4runner 4wd	2.7	1999	4 manual(m5)	4	15	20
## 175	toyota	4runner 4wd	2.7	1999	4 auto(l4)	4	16	20
## 176	toyota	4runner 4wd	3.4	1999	6 auto(l4)	4	15	19
## 177	toyota	4runner 4wd	3.4	1999	6 manual(m5)	4	15	17
## 178	toyota	4runner 4wd	4.0	2008	6 auto(l5)	4	16	20
## 179	toyota	4runner 4wd	4.7	2008	8 auto(l5)	4	14	17
## 180	toyota	camry	2.2	1999	4 manual(m5)	f	21	29
## 181	toyota	camry	2.2	1999	4 auto(l4)	f	21	27
## 182	toyota	camry	2.4	2008	4 manual(m5)	f	21	31
## 183	toyota	camry	2.4	2008	4 auto(l5)	f	21	31
## 184	toyota	camry	3.0	1999	6 auto(l4)	f	18	26
## 185	toyota	camry	3.0	1999	6 manual(m5)	f	18	26
## 186	toyota	camry	3.5	2008	6 auto(s6)	f	19	28
## 187	toyota	camry solara	2.2	1999	4 auto(l4)	f	21	27
## 188	toyota	camry solara	2.2	1999	4 manual(m5)	f	21	29
## 189	toyota	camry solara	2.4	2008	4 manual(m5)	f	21	31
## 190	toyota	camry solara	2.4	2008	4 auto(s5)	f	22	31
## 191	toyota	camry solara	3.0	1999	6 auto(l4)	f	18	26
## 192	toyota	camry solara	3.0	1999	6 manual(m5)	f	18	26
## 193	toyota	camry solara	3.3	2008	6 auto(s5)	f	18	27
## 194	toyota	corolla	1.8	1999	4 auto(l3)	f	24	30
## 195	toyota	corolla	1.8	1999	4 auto(l4)	f	24	33
## 196	toyota	corolla	1.8	1999	4 manual(m5)	f	26	35
## 197	toyota	corolla	1.8	2008	4 manual(m5)	f	28	37
## 198	toyota	corolla	1.8	2008	4 auto(l4)	f	26	35
## 199	toyota	land cruiser wagon 4wd	4.7	1999	8 auto(l4)	4	11	15
## 200	toyota	land cruiser wagon 4wd	5.7	2008	8 auto(s6)	4	13	18
## 201	toyota	toyota tacoma 4wd	2.7	1999	4 manual(m5)	4	15	20
## 202	toyota	toyota tacoma 4wd	2.7	1999	4 auto(l4)	4	16	20
## 203	toyota	toyota tacoma 4wd	2.7	2008	4 manual(m5)	4	17	22
## 204	toyota	toyota tacoma 4wd	3.4	1999	6 manual(m5)	4	15	17
## 205	toyota	toyota tacoma 4wd	3.4	1999	6 auto(l4)	4	15	19
## 206	toyota	toyota tacoma 4wd	4.0	2008	6 manual(m6)	4	15	18
## 207	toyota	toyota tacoma 4wd	4.0	2008	6 auto(l5)	4	16	20
## 208	volkswagen	gti	2.0	1999	4 manual(m5)	f	21	29
## 209	volkswagen	gti	2.0	1999	4 auto(l4)	f	19	26
## 210	volkswagen	gti	2.0	2008	4 manual(m6)	f	21	29
## 211	volkswagen	gti	2.0	2008	4 auto(s6)	f	22	29
## 212	volkswagen	gti	2.8	1999	6 manual(m5)	f	17	24
## 213	volkswagen	jetta	1.9	1999	4 manual(m5)	f	33	44
## 214	volkswagen	jetta	2.0	1999	4 manual(m5)	f	21	29
## 215	volkswagen	jetta	2.0	1999	4 auto(l4)	f	19	26
## 216	volkswagen	jetta	2.0	2008	4 auto(s6)	f	22	29

## 217	volkswagen	jetta	2.0	2008	4	manual(m6)	f	21	29
## 218	volkswagen	jetta	2.5	2008	5	auto(s6)	f	21	29
## 219	volkswagen	jetta	2.5	2008	5	manual(m5)	f	21	29
## 220	volkswagen	jetta	2.8	1999	6	auto(l4)	f	16	23
## 221	volkswagen	jetta	2.8	1999	6	manual(m5)	f	17	24
## 222	volkswagen	new beetle	1.9	1999	4	manual(m5)	f	35	44
## 223	volkswagen	new beetle	1.9	1999	4	auto(l4)	f	29	41
## 224	volkswagen	new beetle	2.0	1999	4	manual(m5)	f	21	29
## 225	volkswagen	new beetle	2.0	1999	4	auto(l4)	f	19	26
## 226	volkswagen	new beetle	2.5	2008	5	manual(m5)	f	20	28
## 227	volkswagen	new beetle	2.5	2008	5	auto(s6)	f	20	29
## 228	volkswagen	passat	1.8	1999	4	manual(m5)	f	21	29
## 229	volkswagen	passat	1.8	1999	4	auto(l5)	f	18	29
## 230	volkswagen	passat	2.0	2008	4	auto(s6)	f	19	28
## 231	volkswagen	passat	2.0	2008	4	manual(m6)	f	21	29
## 232	volkswagen	passat	2.8	1999	6	auto(l5)	f	16	26
## 233	volkswagen	passat	2.8	1999	6	manual(m5)	f	18	26
## 234	volkswagen	passat	3.6	2008	6	auto(s6)	f	17	26
##	fl	class							
## 1	p	compact							
## 2	p	compact							
## 3	p	compact							
## 4	p	compact							
## 5	p	compact							
## 6	p	compact							
## 7	p	compact							
## 8	p	compact							
## 9	p	compact							
## 10	p	compact							
## 11	p	compact							
## 12	p	compact							
## 13	p	compact							
## 14	p	compact							
## 15	p	compact							
## 16	p	midsize							
## 17	p	midsize							
## 18	p	midsize							
## 19	r	suv							
## 20	e	suv							
## 21	r	suv							
## 22	r	suv							
## 23	r	suv							
## 24	p	2seater							
## 25	p	2seater							
## 26	p	2seater							
## 27	p	2seater							
## 28	p	2seater							
## 29	r	suv							
## 30	e	suv							
## 31	r	suv							
## 32	d	suv							
## 33	r	midsize							
## 34	r	midsize							
## 35	r	midsize							

## 36	r	midsize
## 37	r	midsize
## 38	r	minivan
## 39	r	minivan
## 40	r	minivan
## 41	r	minivan
## 42	r	minivan
## 43	r	minivan
## 44	e	minivan
## 45	r	minivan
## 46	r	minivan
## 47	r	minivan
## 48	r	minivan
## 49	r	pickup
## 50	r	pickup
## 51	r	pickup
## 52	r	pickup
## 53	r	pickup
## 54	r	pickup
## 55	e	pickup
## 56	r	pickup
## 57	r	pickup
## 58	r	suv
## 59	r	suv
## 60	e	suv
## 61	r	suv
## 62	r	suv
## 63	r	suv
## 64	r	suv
## 65	r	pickup
## 66	e	pickup
## 67	r	pickup
## 68	r	pickup
## 69	r	pickup
## 70	e	pickup
## 71	r	pickup
## 72	r	pickup
## 73	r	pickup
## 74	r	pickup
## 75	r	suv
## 76	r	suv
## 77	r	suv
## 78	r	suv
## 79	r	suv
## 80	r	suv
## 81	r	suv
## 82	r	suv
## 83	r	suv
## 84	r	pickup
## 85	r	pickup
## 86	r	pickup
## 87	r	pickup
## 88	r	pickup
## 89	r	pickup

```
## 90  r    pickup
## 91  r subcompact
## 92  r subcompact
## 93  r subcompact
## 94  r subcompact
## 95  r subcompact
## 96  r subcompact
## 97  r subcompact
## 98  r subcompact
## 99  p subcompact
## 100 r subcompact
## 101 r subcompact
## 102 r subcompact
## 103 p subcompact
## 104 r subcompact
## 105 r subcompact
## 106 r subcompact
## 107 c subcompact
## 108 p subcompact
## 109 r    midsize
## 110 r    midsize
## 111 r    midsize
## 112 r    midsize
## 113 r    midsize
## 114 r    midsize
## 115 r    midsize
## 116 r subcompact
## 117 r subcompact
## 118 r subcompact
## 119 r subcompact
## 120 r subcompact
## 121 r subcompact
## 122 r subcompact
## 123 d      suv
## 124 r      suv
## 125 r      suv
## 126 r      suv
## 127 e      suv
## 128 r      suv
## 129 r      suv
## 130 p      suv
## 131 p      suv
## 132 r      suv
## 133 r      suv
## 134 p      suv
## 135 r      suv
## 136 p      suv
## 137 r      suv
## 138 r      suv
## 139 r      suv
## 140 r      suv
## 141 r      suv
## 142 r    compact
## 143 r    compact
```

```

## 144 r    midsize
## 145 r    midsize
## 146 p    midsize
## 147 p    midsize
## 148 r    midsize
## 149 r    midsize
## 150 p    midsize
## 151 r      suv
## 152 r      suv
## 153 p      suv
## 154 p      suv
## 155 r    midsize
## 156 p    midsize
## 157 r    midsize
## 158 r    midsize
## 159 p    midsize
## 160 r      suv
## 161 r      suv
## 162 r      suv
## 163 p      suv
## 164 r      suv
## 165 p      suv
## 166 r subcompact
## 167 r subcompact
## 168 r subcompact
## 169 r subcompact
## 170 p    compact
## 171 r    compact
## 172 p    compact
## 173 r    compact
## 174 r      suv
## 175 r      suv
## 176 r      suv
## 177 r      suv
## 178 r      suv
## 179 r      suv
## 180 r    midsize
## 181 r    midsize
## 182 r    midsize
## 183 r    midsize
## 184 r    midsize
## 185 r    midsize
## 186 r    midsize
## 187 r    compact
## 188 r    compact
## 189 r    compact
## 190 r    compact
## 191 r    compact
## 192 r    compact
## 193 r    compact
## 194 r    compact
## 195 r    compact
## 196 r    compact
## 197 r    compact

```

```
## 198 r compact
## 199 r suv
## 200 r suv
## 201 r pickup
## 202 r pickup
## 203 r pickup
## 204 r pickup
## 205 r pickup
## 206 r pickup
## 207 r pickup
## 208 r compact
## 209 r compact
## 210 p compact
## 211 p compact
## 212 r compact
## 213 d compact
## 214 r compact
## 215 r compact
## 216 p compact
## 217 p compact
## 218 r compact
## 219 r compact
## 220 r compact
## 221 r compact
## 222 d subcompact
## 223 d subcompact
## 224 r subcompact
## 225 r subcompact
## 226 r subcompact
## 227 r subcompact
## 228 p midsize
## 229 p midsize
## 230 p midsize
## 231 p midsize
## 232 p midsize
## 233 p midsize
## 234 p midsize
```

```
nrow(mpgdata)
```

```
## [1] 234
```

```
ncol(mpgdata)
```

```
## [1] 11
```

```
# 2. Which manufacturer has the most models in this data set? Which model has
# the most variations? Ans:
```

```
manuf_count <- mpgdata %>% group_by(manufacturer) %>%
count()
manuf_count
```

```
## # A tibble: 15 x 2
## # Groups:   manufacturer [15]
##   manufacturer      n
##   <chr>          <int>
## 1 audi            18
## 2 chevrolet       19
## 3 dodge           37
## 4 ford            25
## 5 honda            9
## 6 hyundai         14
## 7 jeep            8
## 8 land rover       4
## 9 lincoln          3
## 10 mercury         4
## 11 nissan          13
## 12 pontiac         5
## 13 subaru          14
## 14 toyota          34
## 15 volkswagen      27
```

```
colnames(manuf_count) <- c("Manufacturer", "Counts")
manuf_count
```

```
## # A tibble: 15 x 2
## # Groups:   Manufacturer [15]
##   Manufacturer Counts
##   <chr>          <int>
## 1 audi            18
## 2 chevrolet       19
## 3 dodge           37
## 4 ford            25
## 5 honda            9
## 6 hyundai         14
## 7 jeep            8
## 8 land rover       4
## 9 lincoln          3
## 10 mercury         4
## 11 nissan          13
## 12 pontiac         5
## 13 subaru          14
## 14 toyota          34
## 15 volkswagen      27
```

```
# a. Group the manufacturers and find the unique models.
#   Copy the codes and result.
```

```
unique_mods <- mpgdata %>% group_by(manufacturer, model) %>%
distinct() %>% count()
unique_mods
```

```
## # A tibble: 38 x 3
## # Groups:   manufacturer, model [38]
```

```
##      manufacturer model          n
##      <chr>          <chr>        <int>
##  1 audi            a4              7
##  2 audi            a4 quattro      8
##  3 audi            a6 quattro      3
##  4 chevrolet       c1500 suburban 2wd 4
##  5 chevrolet       corvette        5
##  6 chevrolet       k1500 tahoe 4wd   4
##  7 chevrolet       malibu          5
##  8 dodge           caravan 2wd      9
##  9 dodge           dakota pickup 4wd 8
## 10 dodge           durango 4wd      6
## # ... with 28 more rows
```

```
colnames(unique_mods) <- c("Manufacturer", "Model", "Counts")
unique_mods
```

```
## # A tibble: 38 x 3
## # Groups:   Manufacturer, Model [38]
##   Manufacturer Model          Counts
##   <chr>          <chr>        <int>
##  1 audi            a4              7
##  2 audi            a4 quattro      8
##  3 audi            a6 quattro      3
##  4 chevrolet       c1500 suburban 2wd 4
##  5 chevrolet       corvette        5
##  6 chevrolet       k1500 tahoe 4wd   4
##  7 chevrolet       malibu          5
##  8 dodge           caravan 2wd      9
##  9 dodge           dakota pickup 4wd 8
## 10 dodge           durango 4wd      6
## # ... with 28 more rows
```

```
# b. Graph the result by using plot() and ggplot().
#   Write the codes and its result.
```

```
qplot(model, data = mpg, geom = "bar", fill=manufacturer)
```

```
## Warning: 'qplot()' was deprecated in ggplot2 3.4.0.
```

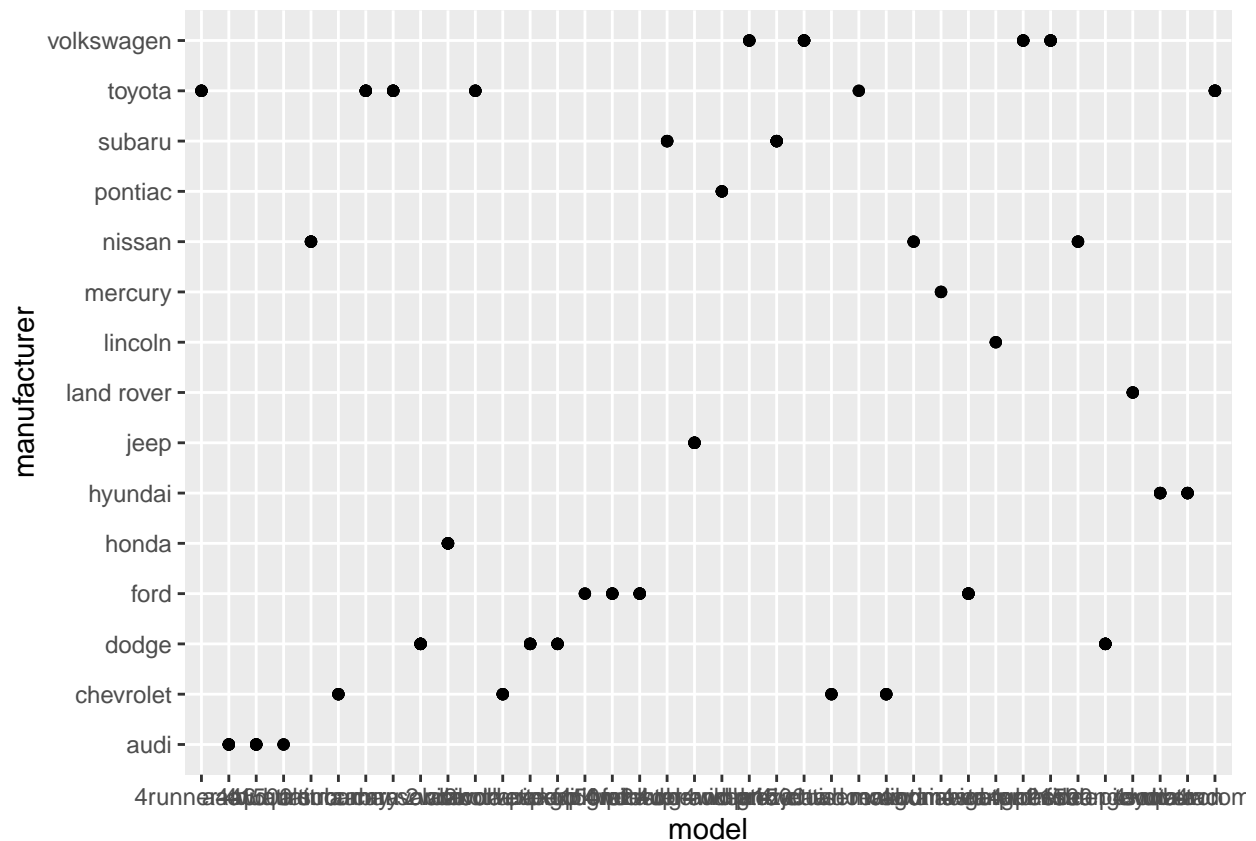


```
colnames(manufmod) <- c("Manufacturer", "Model")
manufmod
```

```
## # A tibble: 38 x 3
## # Groups:   Manufacturer, Model [38]
##   Manufacturer Model      ''
##   <chr>         <chr>      <int>
## 1 audi          a4              7
## 2 audi          a4 quattro      8
## 3 audi          a6 quattro      3
## 4 chevrolet     c1500 suburban 2wd  4
## 5 chevrolet     corvette         5
## 6 chevrolet     k1500 tahoe 4wd    4
## 7 chevrolet     malibu           5
## 8 dodge         caravan 2wd       9
## 9 dodge         dakota pickup 4wd  8
## 10 dodge        durango 4wd       6
## # ... with 28 more rows
```

a. What does `ggplot(mpg, aes(model, manufacturer)) + geom_point()` show?

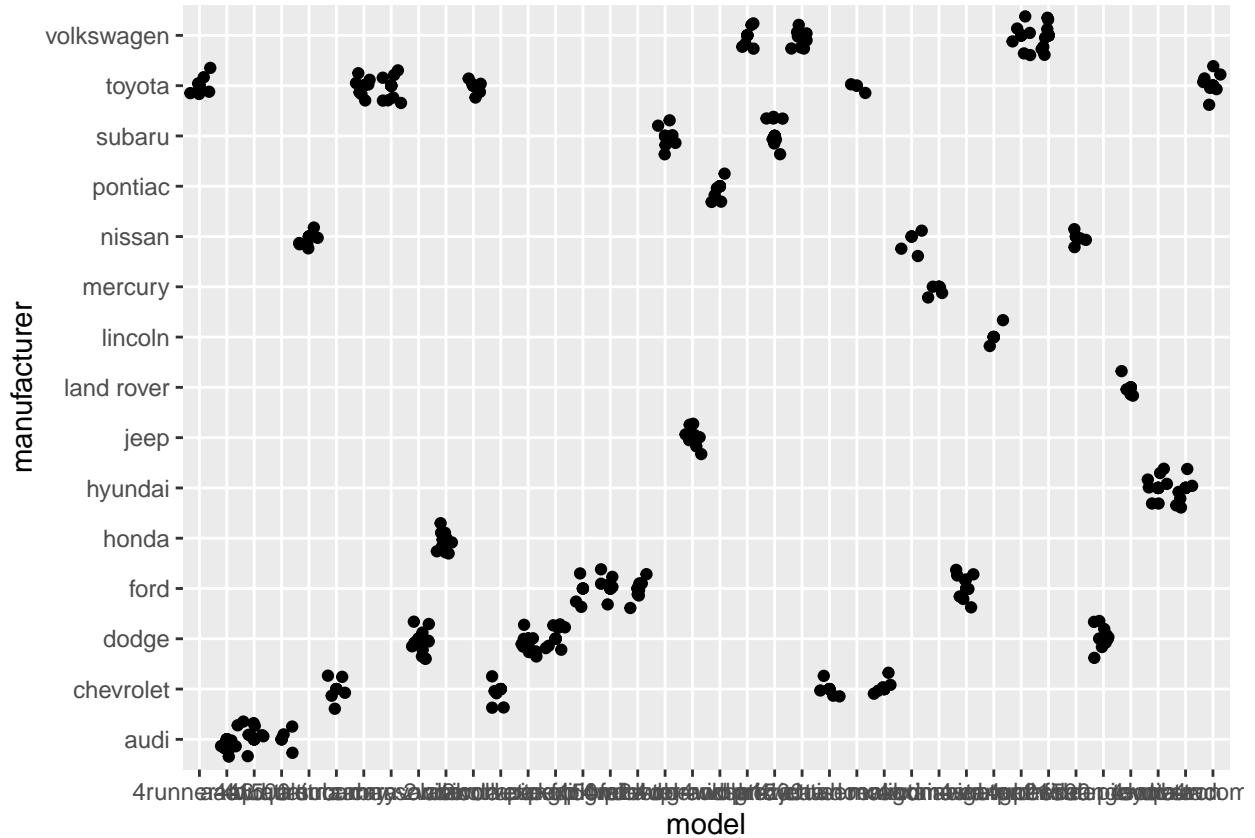
```
ggplot(mpg, aes(model, manufacturer)) + geom_point()
```



```
#geometric point graph of mpg(model and manufacturer)
```

b. For you, is it useful? If not, how could you modify the data to make it
more informative?

```
ggplot(mpg, aes(model, manufacturer)) +  
  geom_point() +  
  geom_jitter()
```



4. Using the pipe (%>%), group the model and get the number of cars per model.
Show codes and its result.

```
mpgdataset <- mpgdata %>% group_by(model) %>% count()
mpgdataset
```

```
## # A tibble: 38 x 2
## # Groups:   model [38]
##   model          n
##   <chr>        <int>
## 1 4runner 4wd         6
## 2 a4                 7
## 3 a4 quattro         8
## 4 a6 quattro         3
## 5 altima            6
```

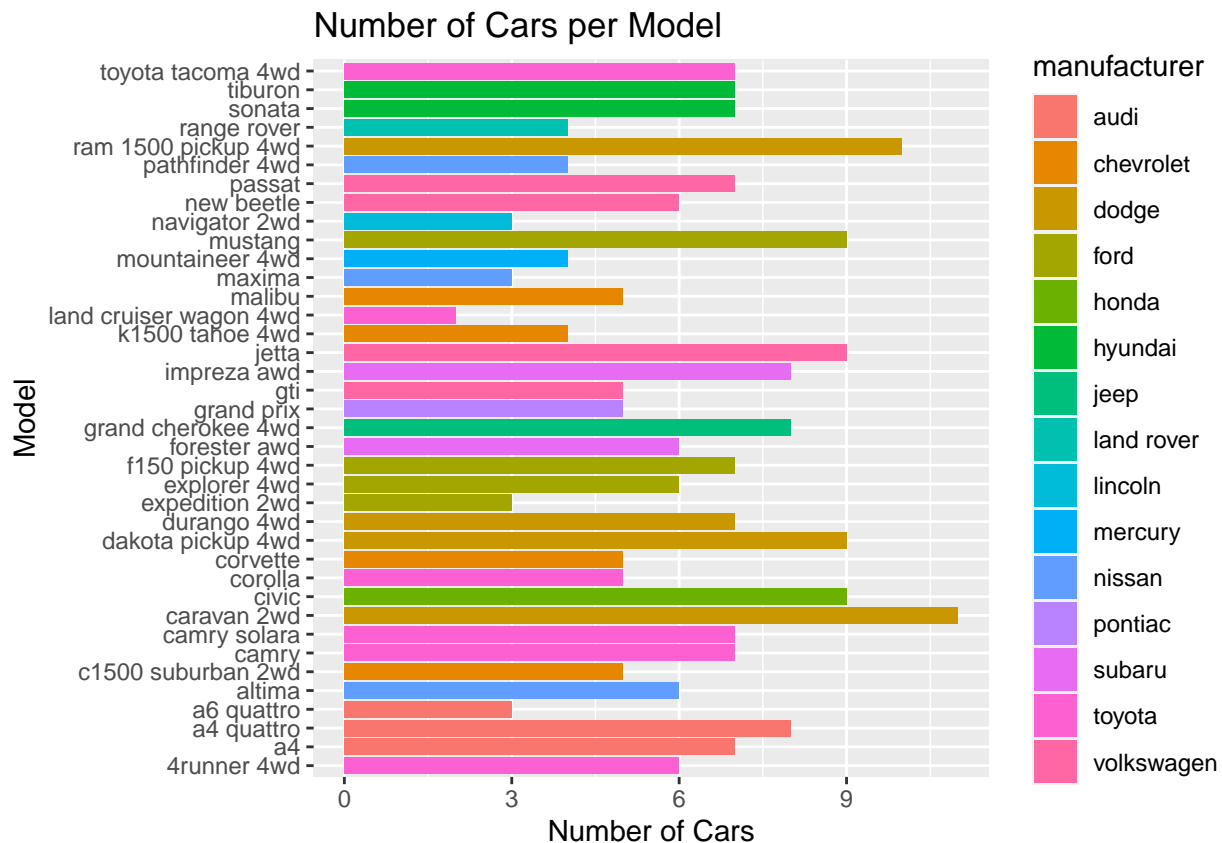
```
## 6 c1500 suburban 2wd      5
## 7 camry                  7
## 8 camry solara           7
## 9 caravan 2wd           11
## 10 civic                 9
## # ... with 28 more rows
```

```
colnames(mpgdataset) <- c("Model","Counts")
mpgdataset
```

```
## # A tibble: 38 x 2
## # Groups:   Model [38]
##   Model      Counts
##   <chr>      <int>
## 1 4runner 4wd      6
## 2 a4            7
## 3 a4 quattro     8
## 4 a6 quattro     3
## 5 altima        6
## 6 c1500 suburban 2wd 5
## 7 camry         7
## 8 camry solara   7
## 9 caravan 2wd    11
## 10 civic        9
## # ... with 28 more rows
```

```
# a. Plot using the geom_bar() + coord_flip() just like what is shown below.
# Show codes and its result.
```

```
qplot(model,data = mpg,main = "Number of Cars per Model", xlab = "Model",
      ylab = "Number of Cars", geom = "bar", fill = manufacturer) +
  coord_flip()
```



b. Use only the top 20 observations. Show code and results.

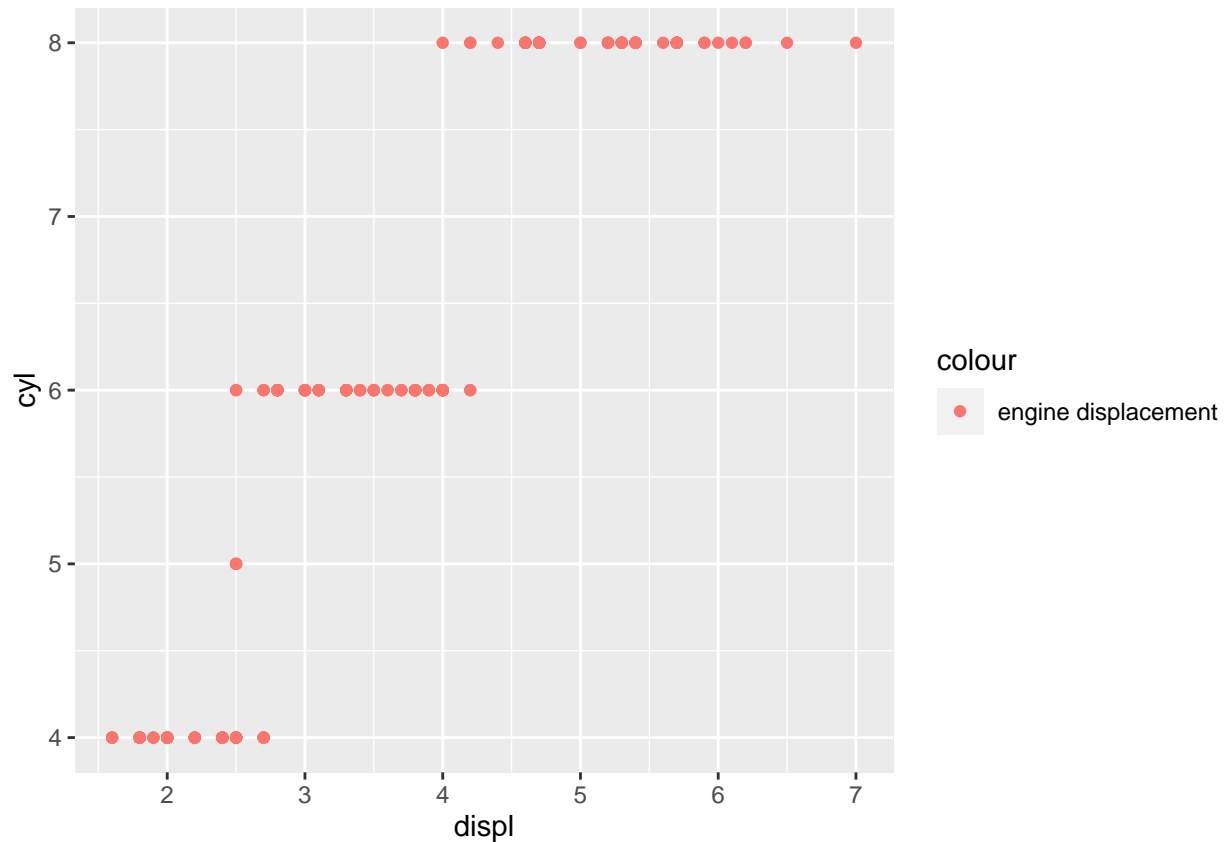
```
mpgdataset <- mpg %>% group_by(model)%>%
  tally(sort = TRUE)
mpgdataset
```

```
## # A tibble: 38 x 2
##   model          n
##   <chr>        <int>
## 1 caravan 2wd      11
## 2 ram 1500 pickup 4wd 10
## 3 civic           9
## 4 dakota pickup 4wd  9
## 5 jetta           9
## 6 mustang         9
## 7 a4 quattro       8
## 8 grand cherokee 4wd 8
## 9 impreza awd      8
## 10 a4              7
## # ... with 28 more rows
```

5. Plot the relationship between cyl - number of cylinders and
displ - engine displacement using geom_point with aesthetic
colour = engine displacement. Title should be
"Relationship between No. of Cylinders and Engine Displacement".

```
# a. Show the codes and its result.
```

```
ggplot(data = mpg , mapping = aes(x = displ, y = cyl, main = "Relationship  
between No of Cylinders and  
Engine Displacement")) +  
  geom_point(mapping=aes(colour = "engine displacement"))
```



```
# b. How would you describe its relationship?
```

```
# Answer:
```

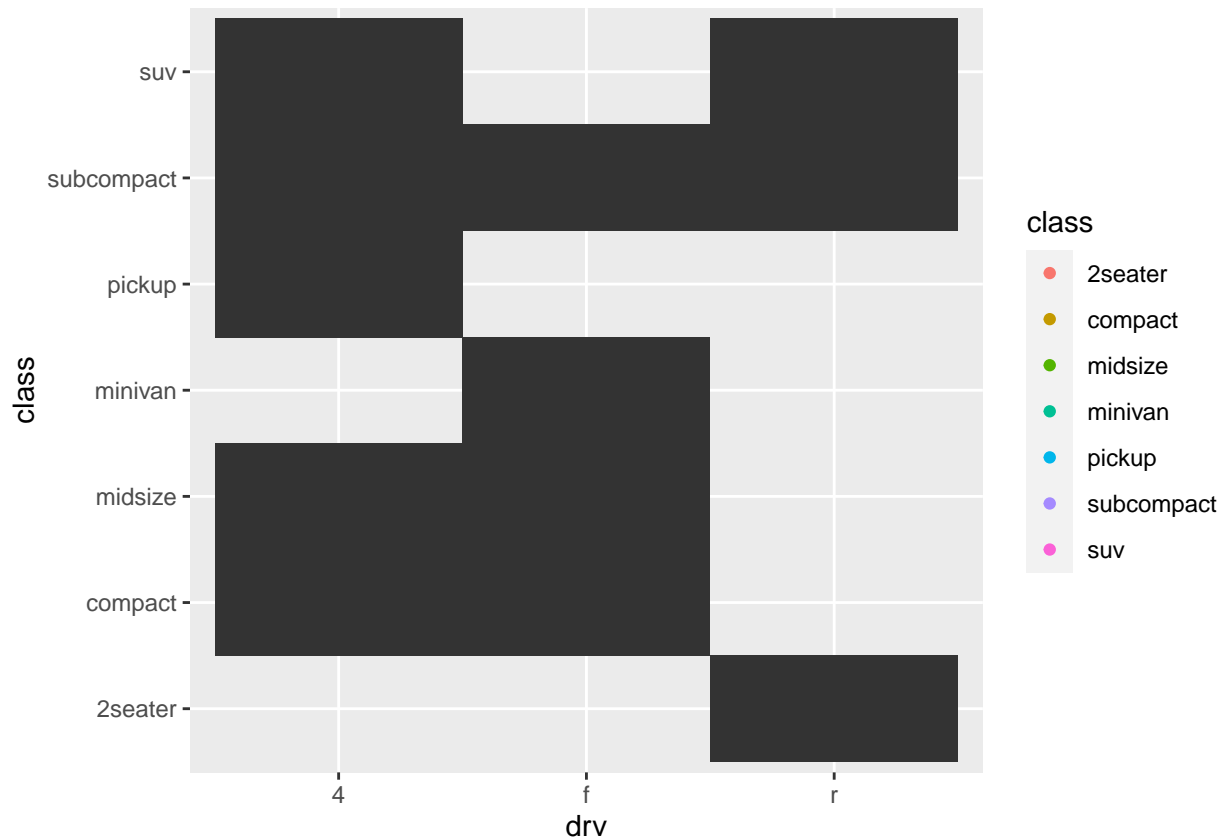
```
# Based on my data, the relationship between cyl and displ is shown through  
# the jittered graph and the pink dots in a horizontal position represent  
# the engine displacement.
```

```
# 6. Get the total number of observations for drv - type of drive train  
# (f = front-wheel drive, r = rear wheel drive, 4 = 4wd) and  
# class - type of class (Example: suv, 2seater, etc.).
```

```
# Plot using the geom_tile() where the number of observations for class be  
# used as a fill for aesthetics.
```

```
# a. Show the codes and its result for the narrative in #6.
```

```
ggplot(data = mpg, mapping = aes(x = drv, y = class)) +  
  geom_point(mapping=aes(color=class)) +  
  geom_tile()
```



```
# b. Interpret the result.
```

```
# Answer:
```

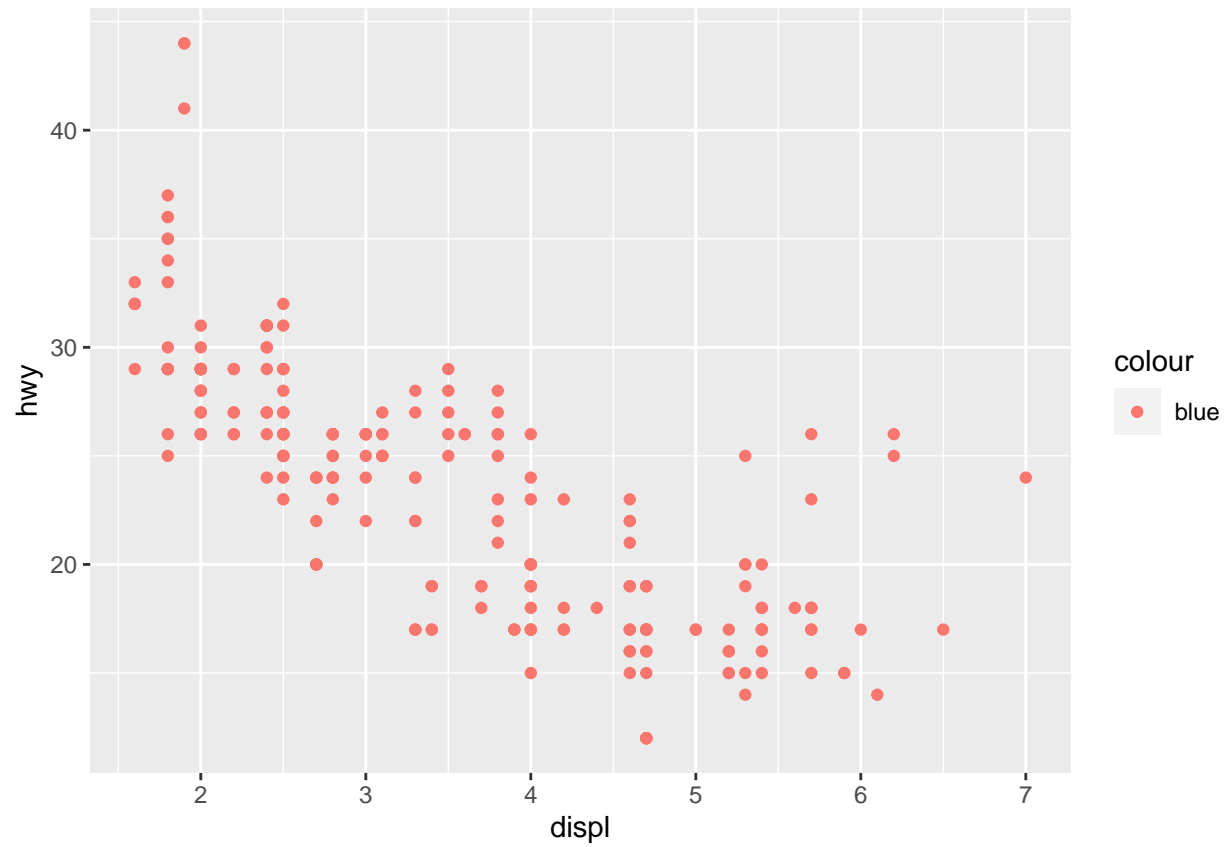
```
# Based on the mapping graph, the drv represents the x-axis, and the class  
# represents the y-axis. As you noticed, the areas in the graph that are  
# mapped are occupied by black shades.
```

```
# 7. Discuss the difference between these codes.
```

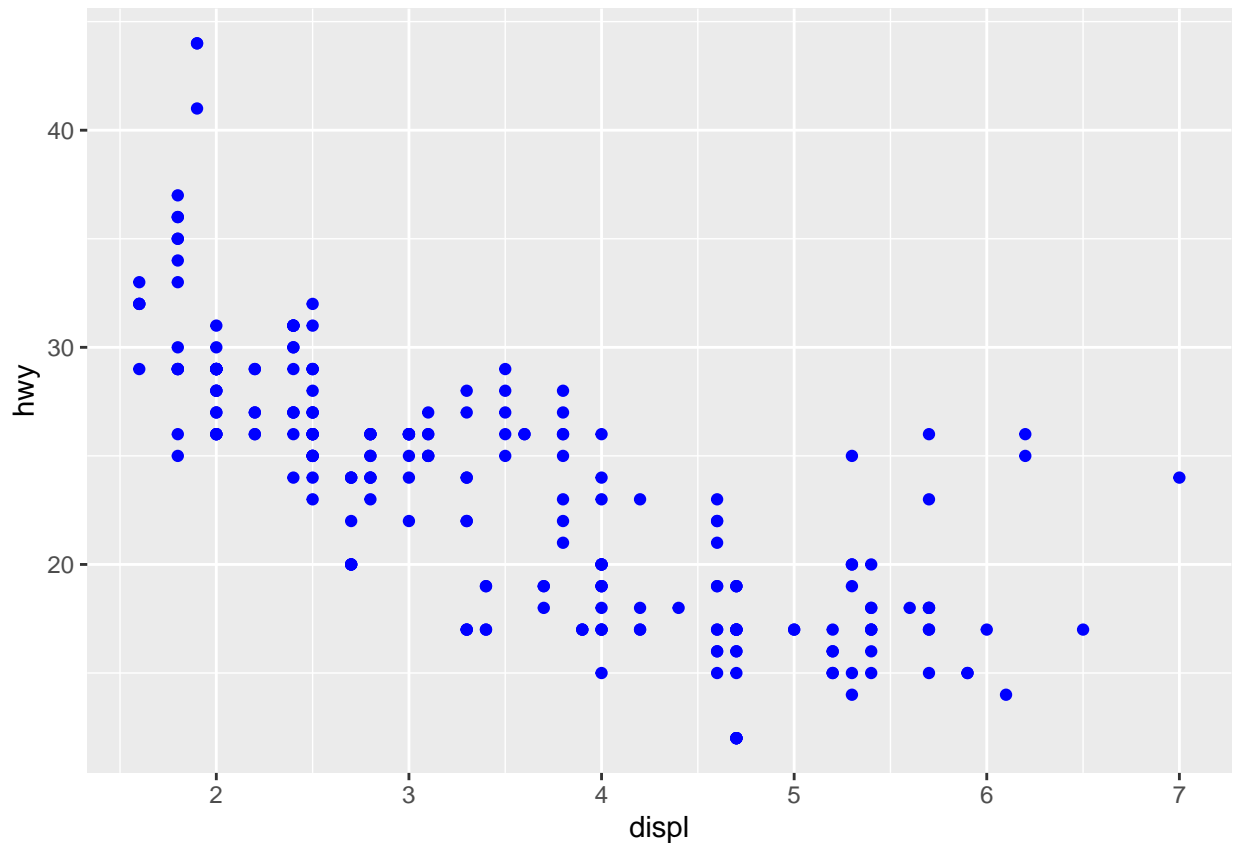
```
# Its outputs for each are shown below.
```

```
# Code #1
```

```
ggplot(data = mpg) +  
  geom_point(mapping = aes(x = displ, y = hwy, colour = "blue"))
```



```
# Code #2
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy), colour = "blue")
```



8. Try to run the command `?mpg`. What is the result of this command?

```
?mpg
```

```
## starting httpd help server ... done
```

Answer:

*# The result of the command shows the data on the help tab about fuel economy
from 1999 to 2008 for 38 popular models.*

a. Which variables from mpg dataset are categorical?

Answer:

*# The categorical variables in the mpg dataset are manufacturer, model,
trans (type of transmission), drv (front-wheel drive, rear-wheel, 4wd),
fl (fuel type), and class (type of car).*

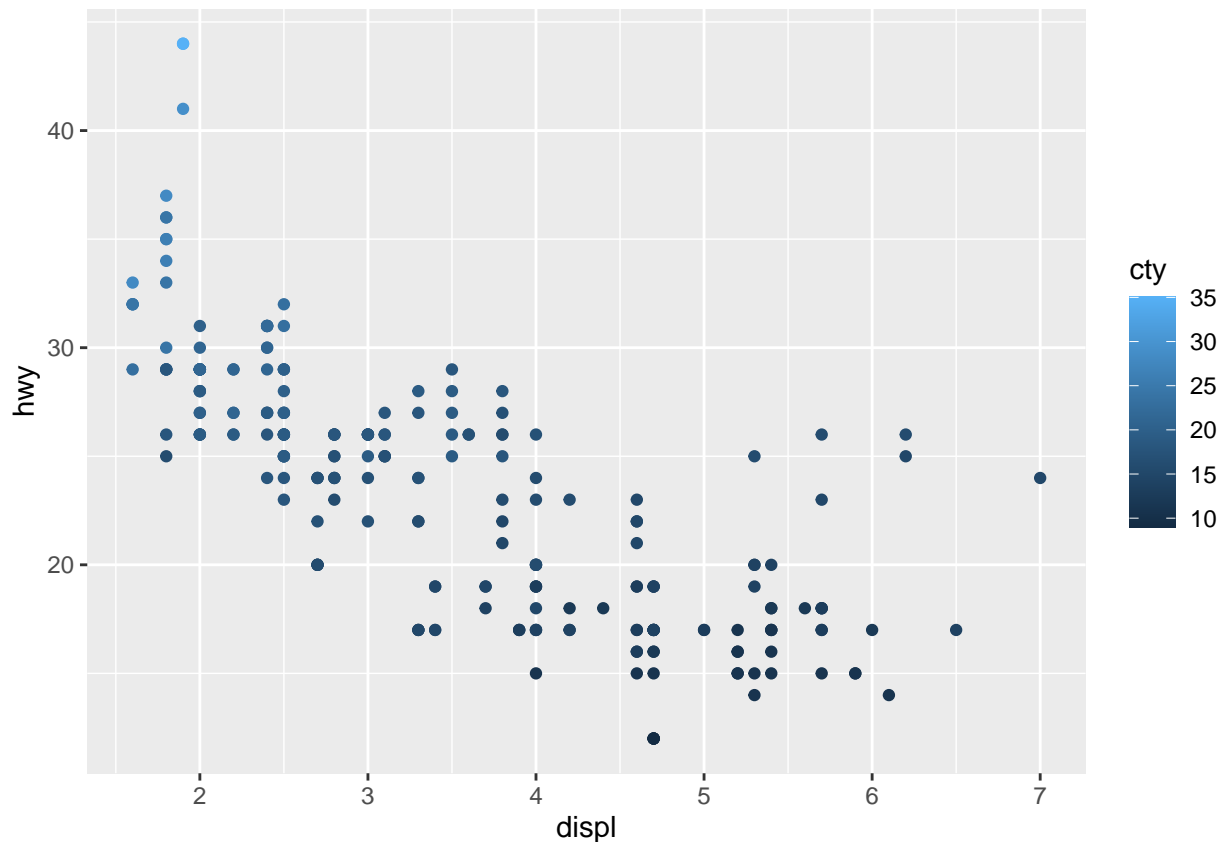
b. Which are continuous variables?

Answer:

*# In contrast, the continuous variables in the mpg dataset are
displ (engine displacement, in litres), year (year of manufacture),
cyl (number of cylinders), cty (city miles per gallon),
and hwy (highway miles per gallon).*


```
# c. Plot the relationship between displ (engine displacement) and hwy
# (highway miles per gallon). Mapped it with a continuous variable you have
# identified in #5-b. What is its result? Why it produced such output?
```

```
# Code:
ggplot(mpg, aes(x = displ, y = hwy, colour = cty)) + geom_point()
```

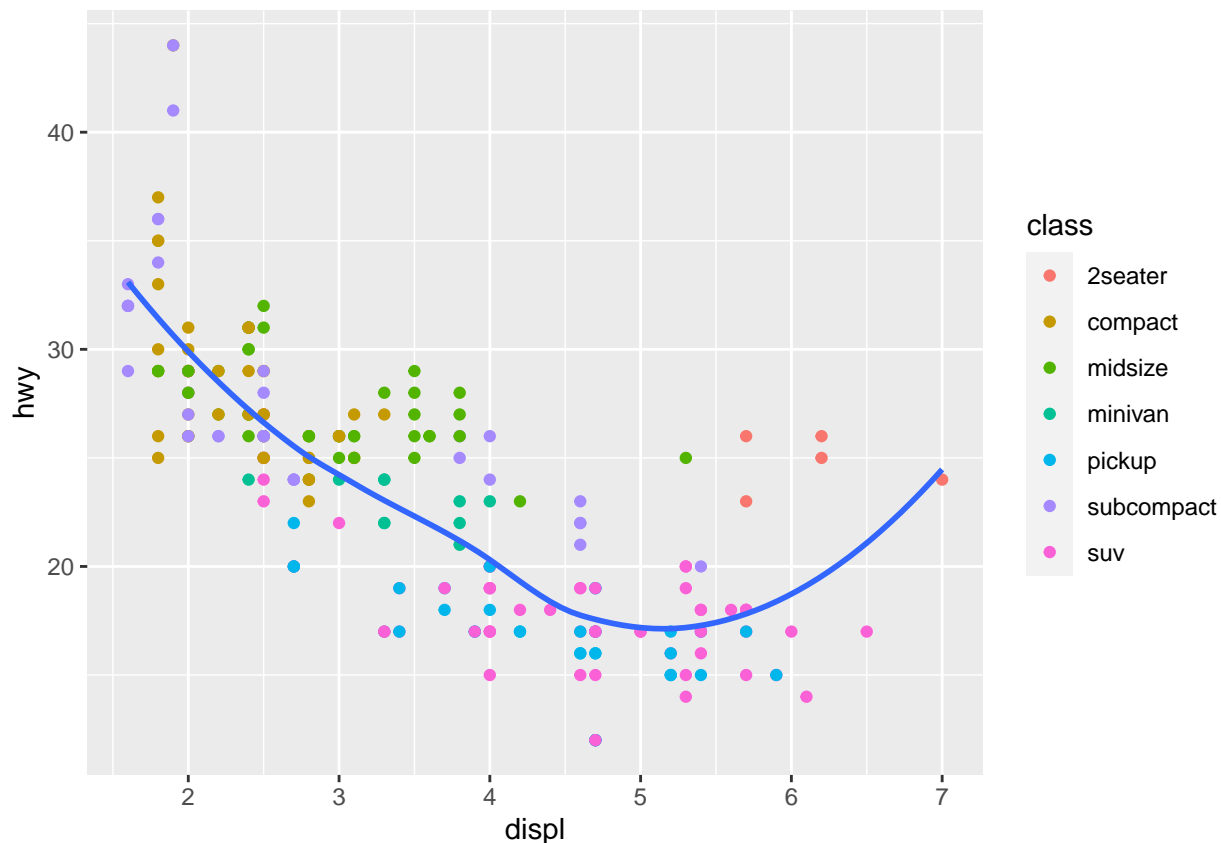


```
# Answer:
# City miles per gallon, or cty, is a continuous variable.
# The continuous variable employs a scale that ranges from light to
# dark blue instead of distinct colors.
```

```
# 9. Plot the relationship between displ (engine displacement) and hwy
# (highway miles per gallon) using geom_point(). Add a trend line over the
# existing plot using geom_smooth() with se = FALSE.
# Default method is "loess"
```

```
ggplot(data = mpg, mapping = aes(x = displ, y = hwy)) +
  geom_point(mapping=aes(color=class)) +
  geom_smooth(se = FALSE)
```

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



*# 10. Using the relationship of displ and hwy, add a trend line over
existing plot. Set these = FALSE to remove the confidence interval and
method = lm to check for linear modeling.*

```
ggplot(data = mpg, mapping = aes(x = displ, y = hwy, color = class)) +  
  geom_point() +  
  geom_smooth(se = FALSE)
```

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

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : span too small. fewer data values than degrees of freedom.
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : pseudoinverse used at 5.6935
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : neighborhood radius 0.5065
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : reciprocal condition number 0
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : There are other near singularities as well. 0.65044
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : pseudoinverse used at 4.008
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : neighborhood radius 0.708
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : reciprocal condition number 0
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =  
## parametric, : There are other near singularities as well. 0.25
```

