

RWorksheet-6

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```
library(ggplot2)
library(dplyr)
```

```
##
## 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
```

```
data(mpg)
```

```
df <- as.data.frame(mpg)
df
```

```
##      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(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(14)	4	20	26
## 165	subaru	forester awd	2.5	2008	4	auto(14)	4	18	23
## 166	subaru	impreza awd	2.2	1999	4	auto(14)	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(14)	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(14)	4	16	20
## 176	toyota	4runner 4wd	3.4	1999	6	auto(14)	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(15)	4	16	20
## 179	toyota	4runner 4wd	4.7	2008	8	auto(15)	4	14	17
## 180	toyota	camry	2.2	1999	4	manual(m5)	f	21	29
## 181	toyota	camry	2.2	1999	4	auto(14)	f	21	27
## 182	toyota	camry	2.4	2008	4	manual(m5)	f	21	31
## 183	toyota	camry	2.4	2008	4	auto(15)	f	21	31
## 184	toyota	camry	3.0	1999	6	auto(14)	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(14)	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
```

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

```
mpg_dataset <- glimpse(df)
```

```
## 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~
```

2. Which manufacturer has the most models in this data set? Which model has the most variations?

Answer: There are 11 columns and 234 rows in mpg dataset

```
mf <- mpg_dataset %>%
  group_by(manufacturer, model) %>% tally(sort = TRUE)
mf
```

```
## # A tibble: 38 x 3
## # Groups:   manufacturer [15]
##   manufacturer model          n
##   <chr>         <chr>      <int>
## 1 dodge       caravan 2wd         11
## 2 dodge       ram 1500 pickup 4wd     10
## 3 dodge       dakota pickup 4wd      9
## 4 ford        mustang             9
## 5 honda       civic              9
## 6 volkswagen  jetta              9
## 7 audi        a4 quattro         8
## 8 jeep        grand cherokee 4wd     8
## 9 subaru      impreza awd         8
## 10 audi       a4                 7
## # ... with 28 more rows
```

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

```
unique_model <- mpg_dataset %>% group_by(manufacturer, model) %>% distinct(model) %>% count()
unique_model
```

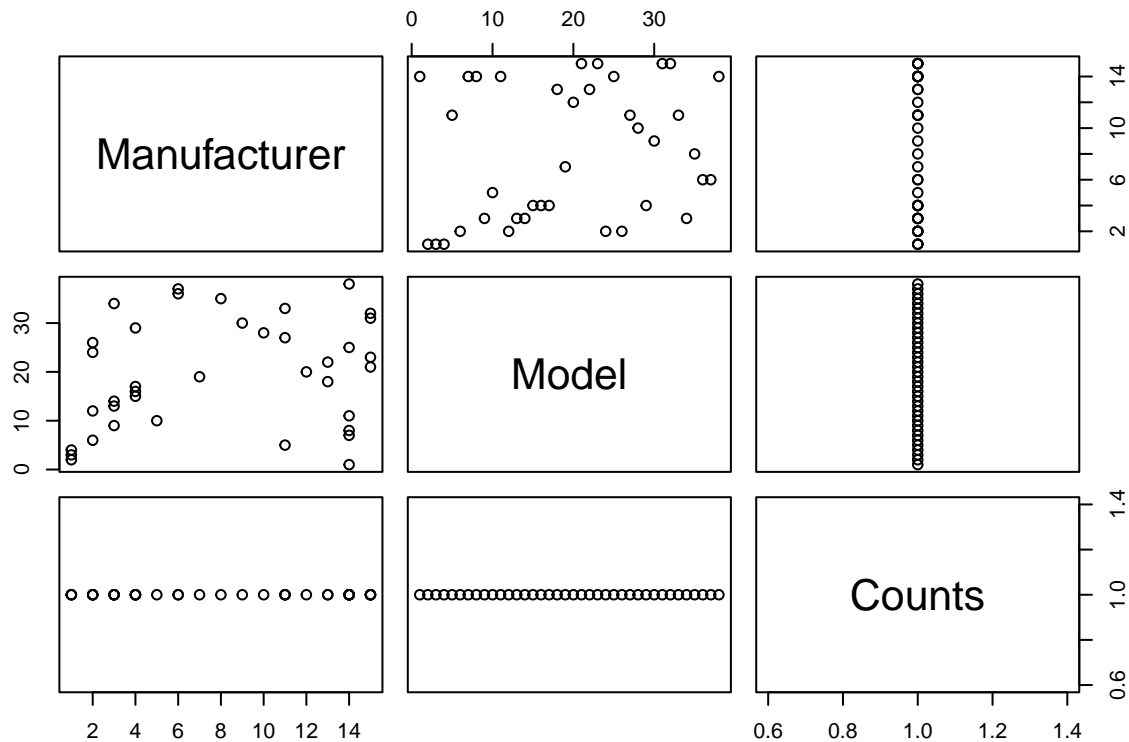
```
## # A tibble: 38 x 3
## # Groups:   manufacturer, model [38]
##   manufacturer model          n
##   <chr>         <chr>        <int>
## 1 audi          a4              1
## 2 audi          a4 quattro         1
## 3 audi          a6 quattro         1
## 4 chevrolet     c1500 suburban 2wd    1
##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

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

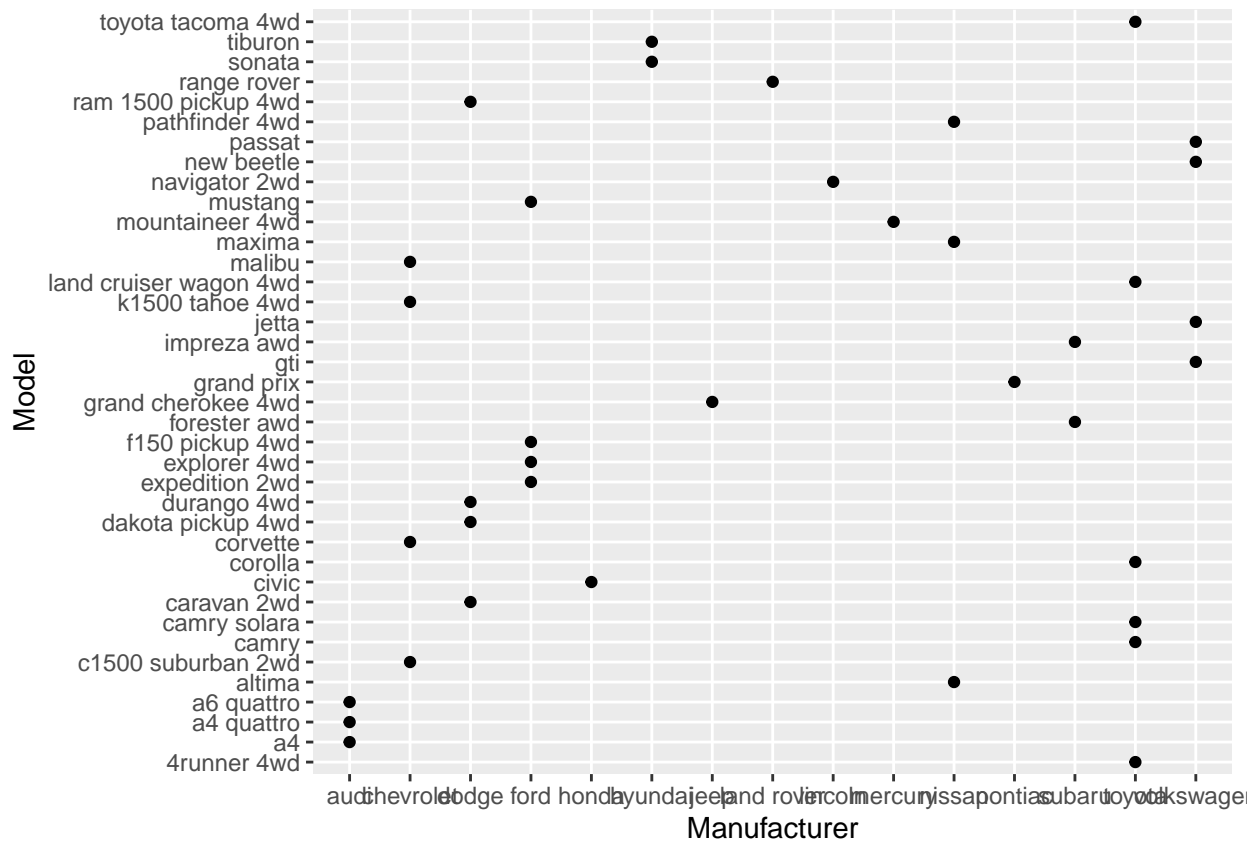
```
## # A tibble: 38 x 3
## # Groups:   Manufacturer, Model [38]
##   Manufacturer Model          Counts
##   <chr>         <chr>        <int>
## 1 audi          a4              1
## 2 audi          a4 quattro         1
## 3 audi          a6 quattro         1
## 4 chevrolet     c1500 suburban 2wd  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

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

```
plot(unique_model)
```

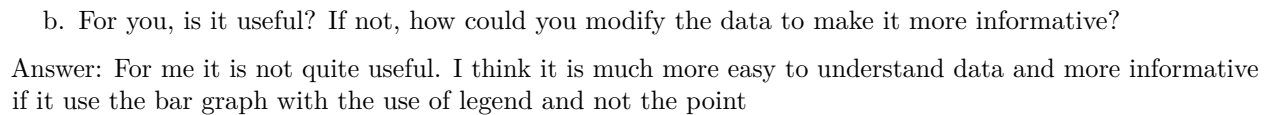


```
ggplot(unique_model, aes(Manufacturer, Model)) + geom_point()
```



3. Same dataset will be used. You are going to show the relationship of the model and the manufacturer

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



Answer: For me it is not quite useful. I think it is much more easy to understand data and more informative if it use the bar graph with the use of legend and not the point

```
car_per_model <- mpg_dataset %>% group_by(model) %>% count()
car_per_model
```

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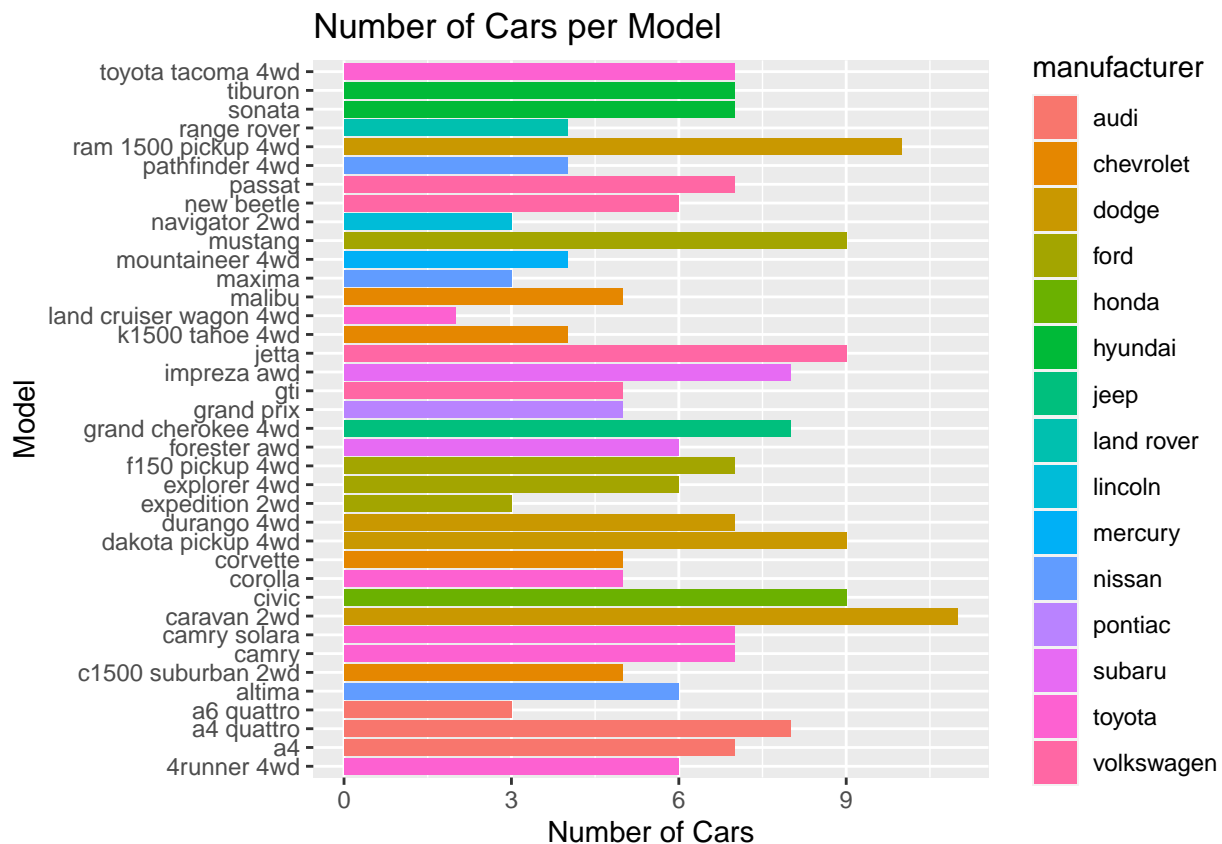
```
colnames(car_per_model) <- c("Model", "Counts")
car_per_model
```

```
## # 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 = df,
      main = "Number of Cars per Model",
      xlab = "Model",
      ylab = "Number of Cars", geom = "bar", fill = manufacturer) + coord_flip()
```

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



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

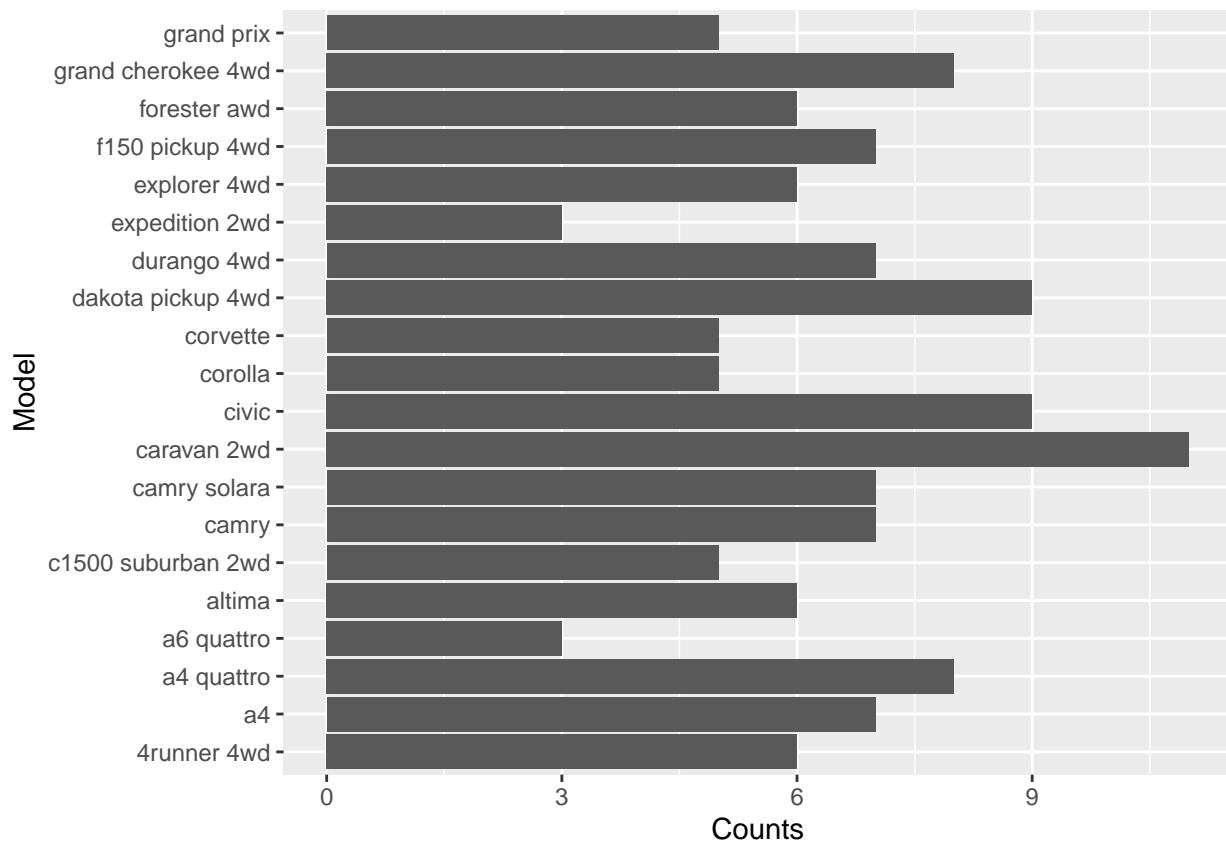
```
top20 <- car_per_model[1:20,] %>% top_n(2)
```

```
## Selecting by Counts
```

```
top20
```

```
## # A tibble: 20 x 2
## # Groups:   Model [20]
##   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
## 11 corolla              5
## 12 corvette             5
## 13 dakota pickup 4wd     9
## 14 durango 4wd          7
## 15 expedition 2wd       3
## 16 explorer 4wd         6
## 17 f150 pickup 4wd       7
## 18 forester awd         6
## 19 grand cherokee 4wd    8
## 20 grand prix           5
```

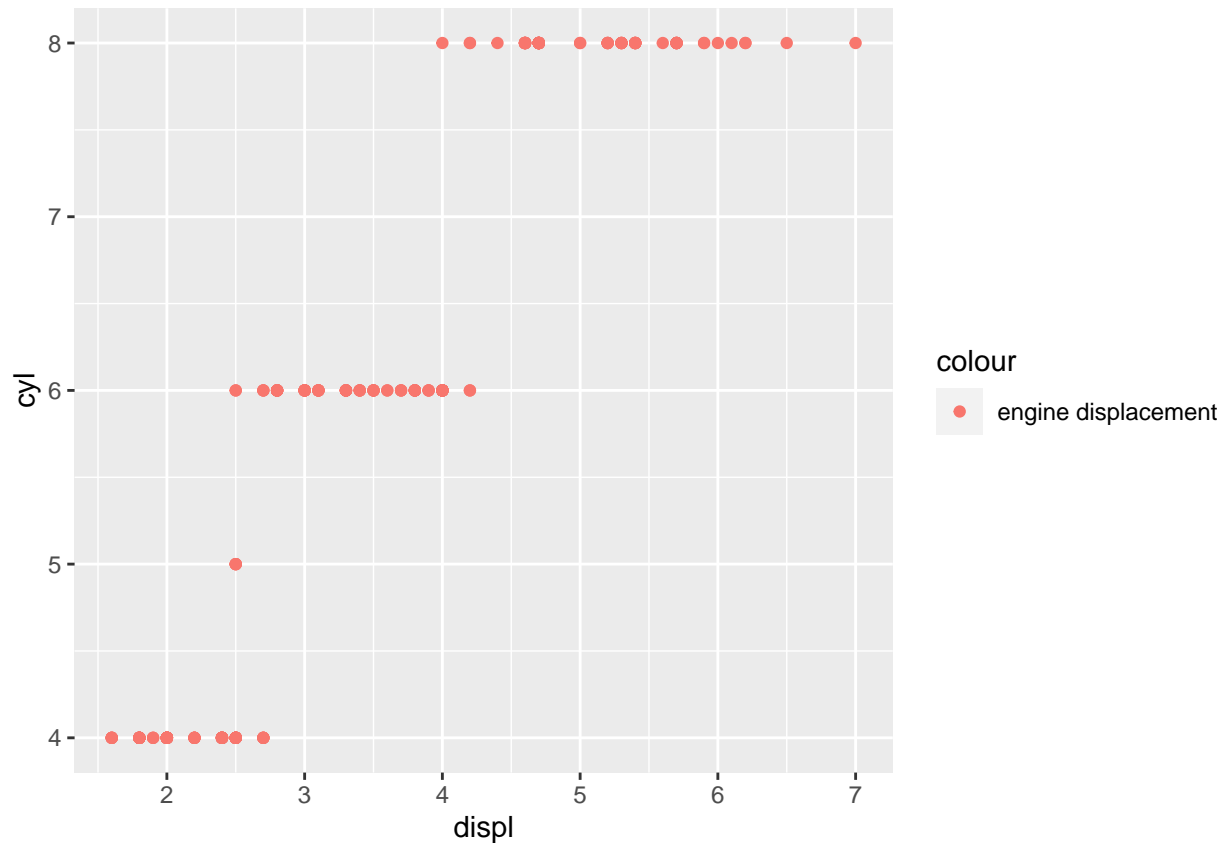
```
ggplot(top20,aes(x = Model, y = Counts)) + geom_bar(stat = "Identity") +coord_flip()
```



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_dataset , mapping = aes(x = displ, y = cyl, main = "Relationship between No of Cylinders and Engine Displacement"))
```

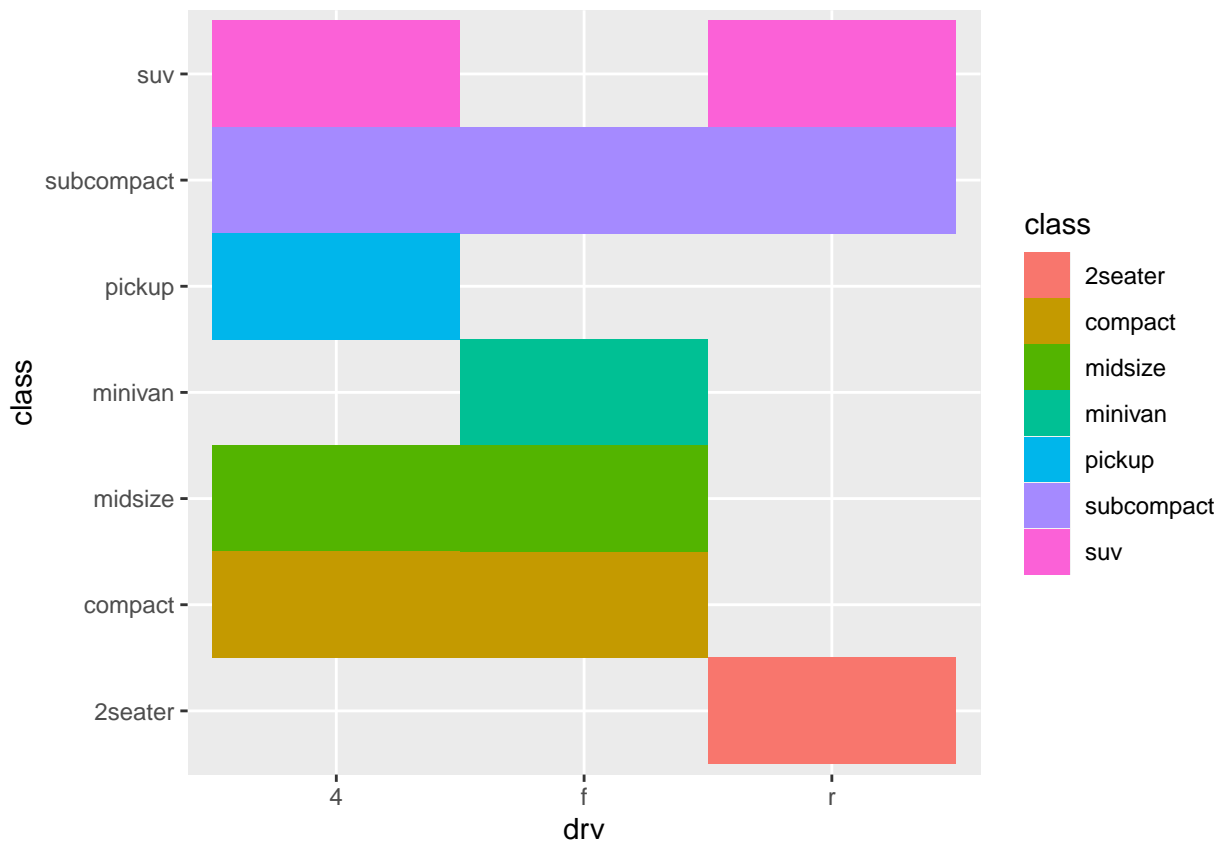
b. How would you describe its relationship?

Answer: The scattered plot show where the engine displacement clustered

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_dataset, mapping = aes(x = drv, y = class)) +
  geom_tile(aes(fill=class))
```



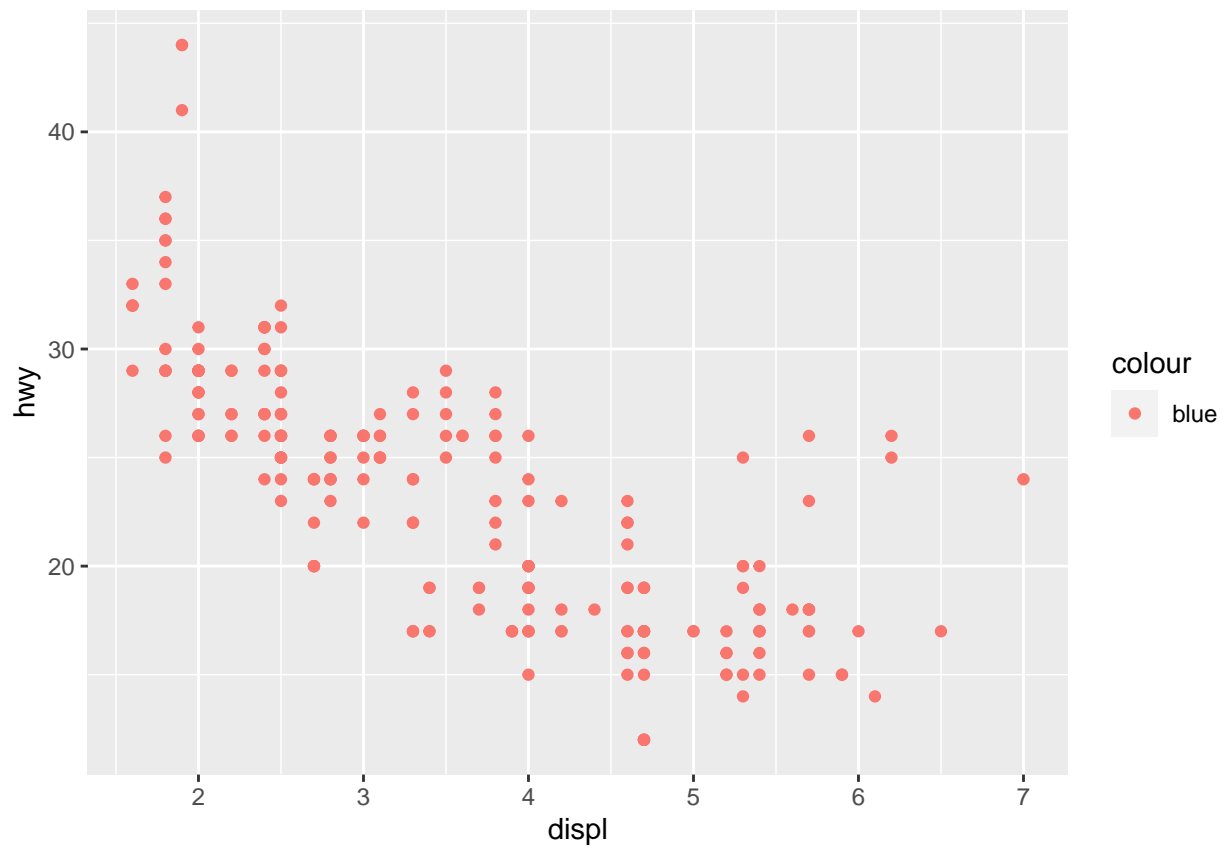
b. Interpret the result. Answer: In this plot there are a lot of missing tiles maybe because of the unobserved class.

7. Discuss the difference between these codes. Its outputs for each are shown below.

Answer: As what I have notice the code 1 is not color blue even if you put the the color blue while in the code 2 is correct and it show the blue color. The diffences between the 2 code is that the colour. The colour() must inside the parenthesis or belong inside the mapping() argument not in aes()

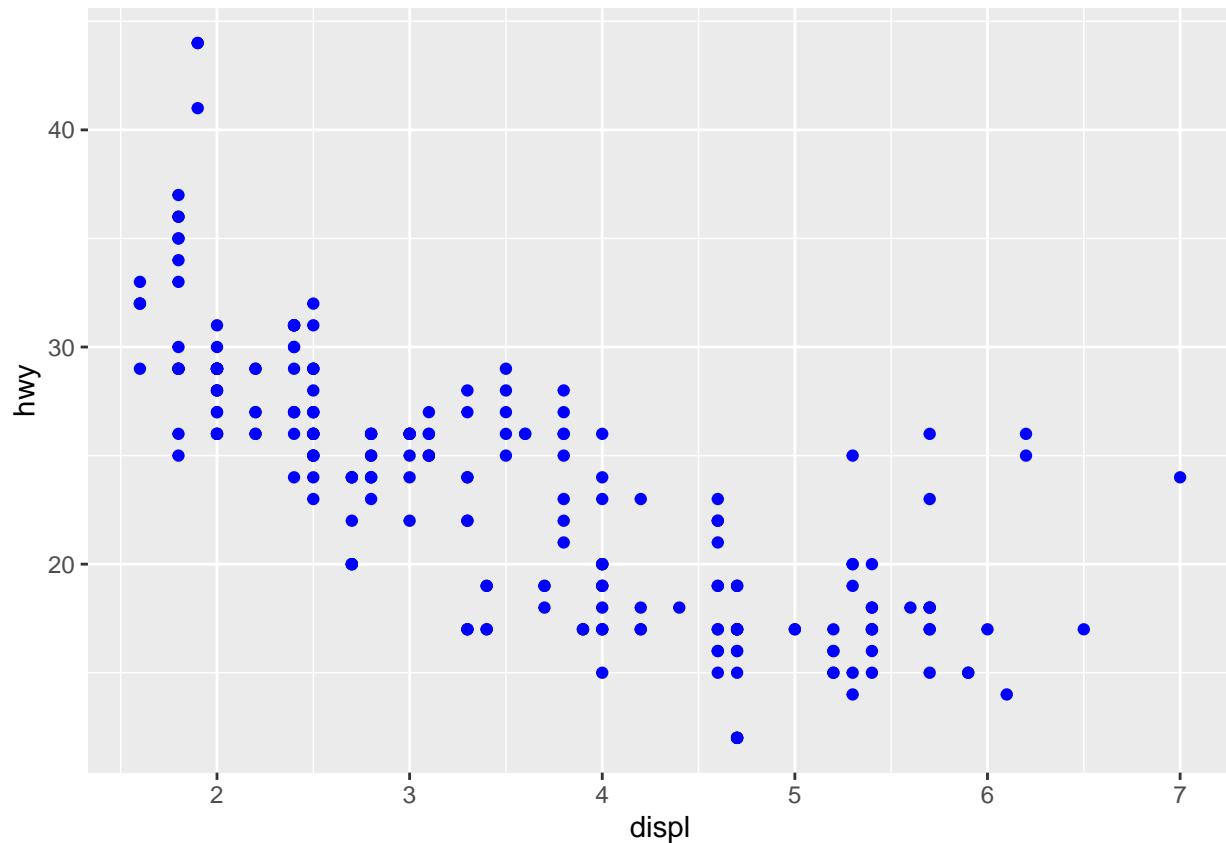
- Code #1

```
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?

a. Which variables from mpg dataset are categorical?

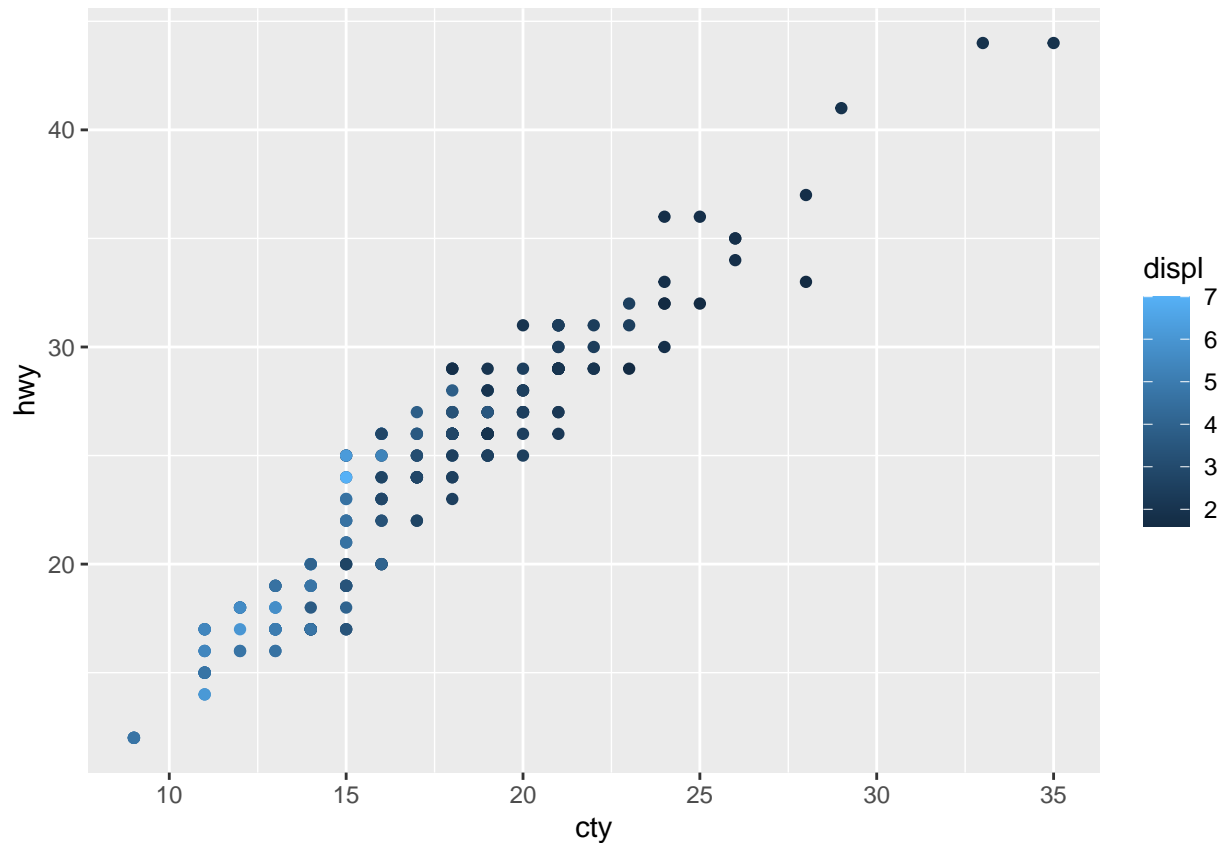
```
con_varb <- ?mpg
con_varb
```

b. Which are continuous variables?

Answer: The list of the continuous variables in mpg are: `displ`, `year`, `cyl`, and `cty`.

c. Plot the relationship between `displ` (engine displacement) and `hwy` (highway miles per gallon). Map it with a continuous variable you have identified in #5-b. What is its result? Why it produced such output? The output shows the plot that contains of continuous variable from light to dark color blue.

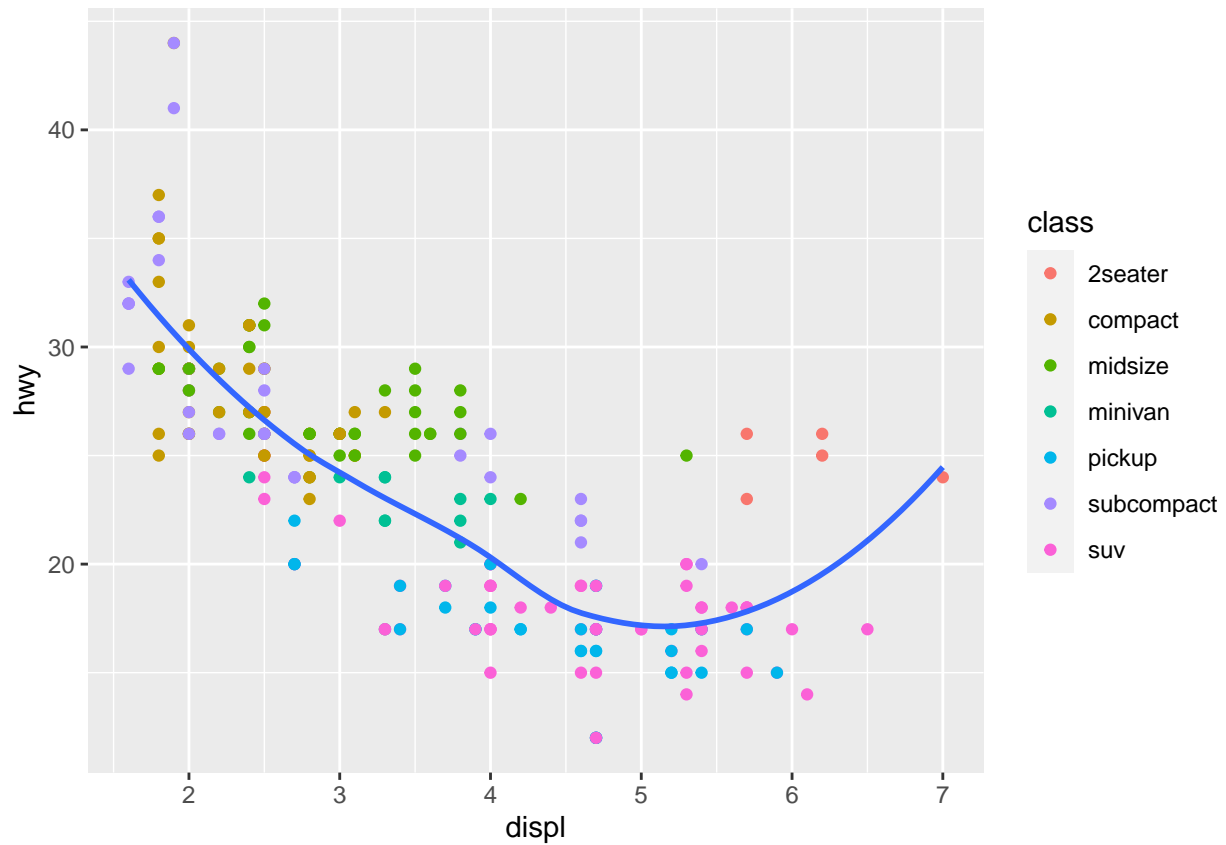
```
ggplot(mpg, aes(x = cty, y = hwy, colour = displ)) + geom_point()
```



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 the `se = 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, method = lm)
```

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

