

RWorksheet_sayson#4c

Adrian T. Sayson

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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
```

```
library(RColorBrewer)
library(readxl)
library(dplyr)
```

```
#1

data(mpg)

write.csv(mpg, "mpg.csv", row.names = FALSE)
```

```
#a
mpg <- read.csv("mpg.csv", stringsAsFactors = FALSE)

mpg
```

```
##      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(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(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(14)	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(13)	f	24	30
## 195	toyota	corolla	1.8	1999	4 auto(14)	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(14)	f	26	35
## 199	toyota	land cruiser wagon 4wd	4.7	1999	8 auto(14)	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(14)	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(14)	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(15)	4	16	20
## 208	volkswagen	gti	2.0	1999	4 manual(m5)	f	21	29
## 209	volkswagen	gti	2.0	1999	4 auto(14)	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(14)	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(14)	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(14)	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(14)	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
```

```
#b
str(mpg)
```

```
## 'data.frame': 234 obs. of 11 variables:
## $ manufacturer: chr "audi" "audi" "audi" "audi" ...
## $ model : chr "a4" "a4" "a4" "a4" ...
## $ displ : num 1.8 1.8 2 2 2.8 2.8 3.1 1.8 1.8 2 ...
## $ year : int 1999 1999 2008 2008 1999 1999 2008 1999 1999 2008 ...
## $ cyl : int 4 4 4 4 6 6 6 4 4 4 ...
## $ trans : chr "auto(l5)" "manual(m5)" "manual(m6)" "auto(av)" ...
## $ drv : chr "f" "f" "f" "f" ...
## $ cty : int 18 21 20 21 16 18 18 18 16 20 ...
## $ hwy : int 29 29 31 30 26 26 27 26 25 28 ...
## $ fl : chr "p" "p" "p" "p" ...
## $ class : chr "compact" "compact" "compact" "compact" ...
```

```
#All characters and factors are categorical.
```

```
#c
str(mpg)
```

```
## 'data.frame': 234 obs. of 11 variables:
## $ manufacturer: chr "audi" "audi" "audi" "audi" ...
```

```
## $ model      : chr "a4" "a4" "a4" "a4" ...
## $ displ      : num 1.8 1.8 2 2 2.8 2.8 3.1 1.8 1.8 2 ...
## $ year       : int 1999 1999 2008 2008 1999 1999 2008 1999 1999 2008 ...
## $ cyl        : int 4 4 4 4 6 6 6 4 4 4 ...
## $ trans      : chr "auto(l5)" "manual(m5)" "manual(m6)" "auto(av)" ...
## $ drv        : chr "f" "f" "f" "f" ...
## $ cty        : int 18 21 20 21 16 18 18 18 16 20 ...
## $ hwy        : int 29 29 31 30 26 26 27 26 25 28 ...
## $ fl         : chr "p" "p" "p" "p" ...
## $ class      : chr "compact" "compact" "compact" "compact" ...
```

#All numeric are continous.

#2

```
mpg %>%
  group_by(manufacturer) %>%
  summarise(models = n_distinct(model))
```

```
## # A tibble: 15 x 2
##   manufacturer models
##   <chr>          <int>
## 1 audi           3
## 2 chevrolet      4
## 3 dodge          4
## 4 ford           4
## 5 honda          1
## 6 hyundai        2
## 7 jeep           1
## 8 land rover     1
## 9 lincoln        1
## 10 mercury       1
## 11 nissan         3
## 12 pontiac       1
## 13 subaru        2
## 14 toyota        6
## 15 volkswagen    4
```

#a

```
unique_models <- mpg %>%
  group_by(manufacturer) %>%
  summarise(unique_models = n_distinct(model)) %>%
  arrange(desc(unique_models))

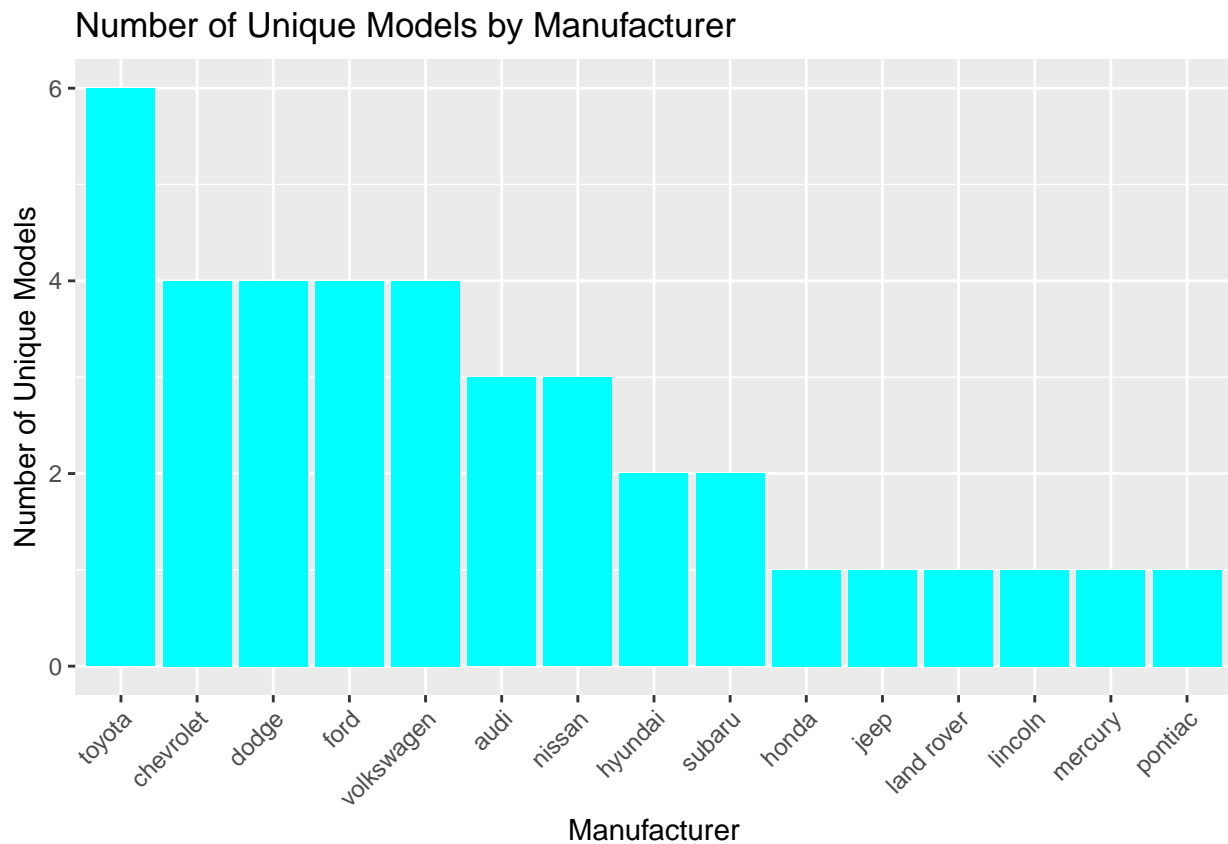
unique_models
```

```
## # A tibble: 15 x 2
##   manufacturer unique_models
##   <chr>          <int>
## 1 toyota         6
## 2 chevrolet      4
## 3 dodge          4
## 4 ford           4
## 5 volkswagen    4
```

```
## 6 audi          3
## 7 nissan         3
## 8 hyundai       2
## 9 subaru        2
## 10 honda        1
## 11 jeep         1
## 12 land rover   1
## 13 lincoln      1
## 14 mercury      1
## 15 pontiac      1
```

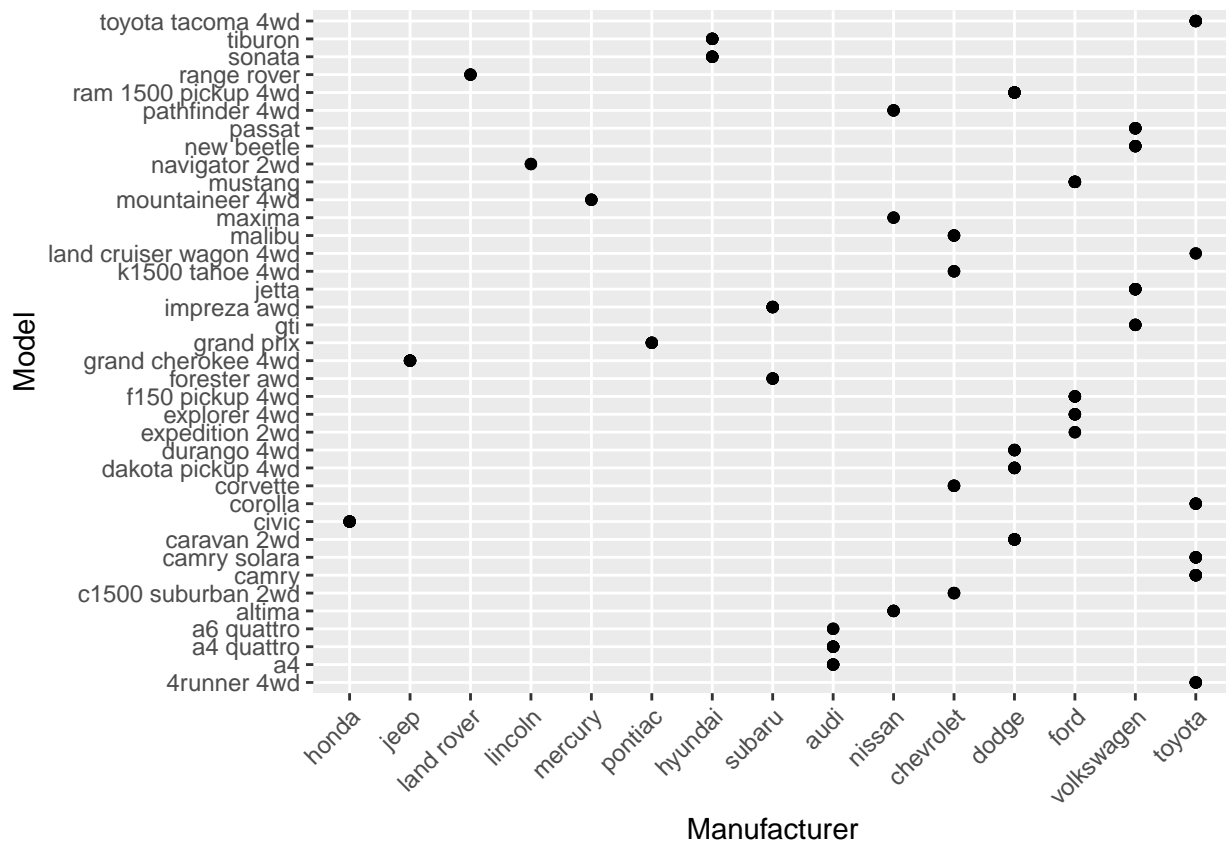
```
#b
```

```
ggplot(unique_models, aes(x = reorder(manufacturer, -unique_models), y = unique_models)) +
  geom_bar(stat = "identity", fill = "cyan") +
  xlab("Manufacturer") + ylab("Number of Unique Models") +
  ggtitle("Number of Unique Models by Manufacturer") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



```
#c
```

```
ggplot(mpg, aes(x = reorder(manufacturer, model, function(x) length(unique(x))), y = model)) +
  geom_point() +
  xlab("Manufacturer") +
  ylab("Model") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



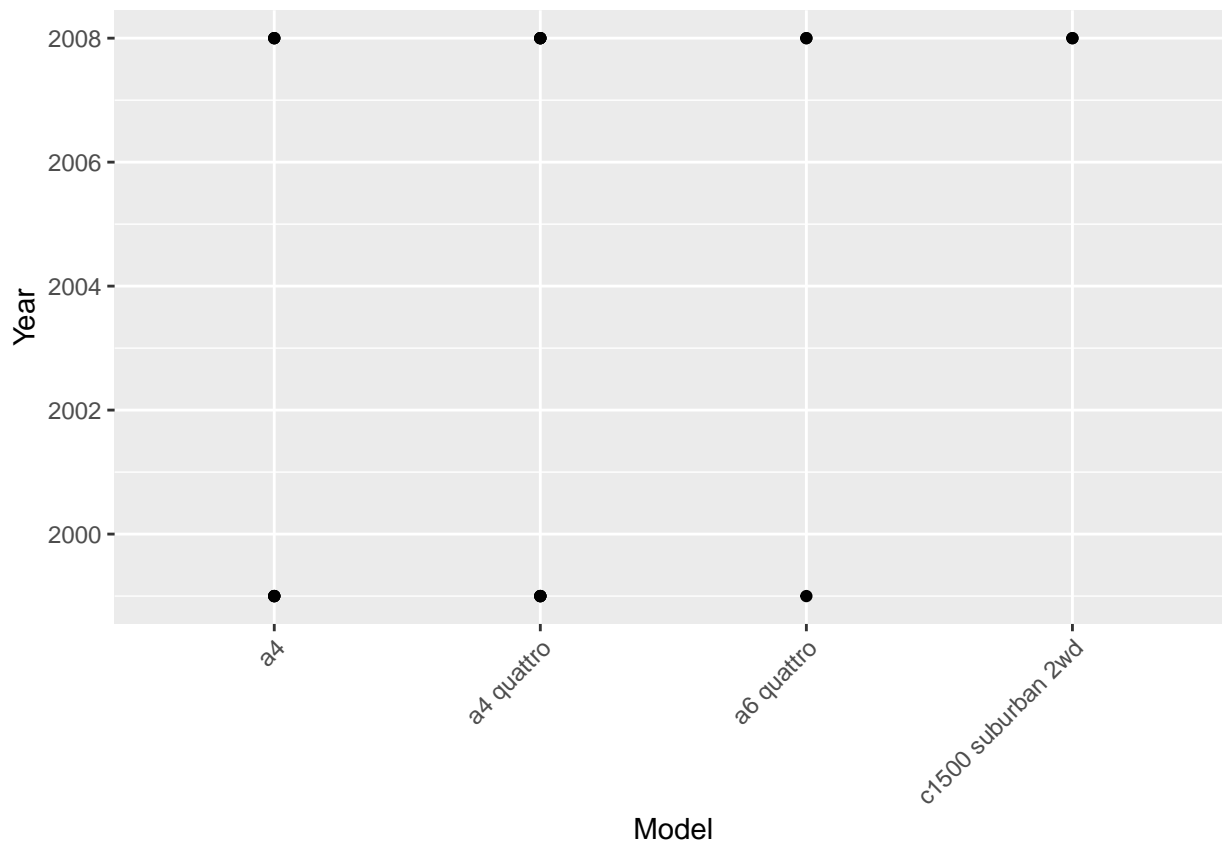
#b

#No, barplot is easier to understand.

#3

```
top_20 <- head(mpg, 20)
```

```
ggplot(top_20, aes(x = model, y = year)) +
  geom_point() +
  xlab("Model") + ylab("Year") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



#4

```
mpg %>%
  group_by(model) %>%
  summarise(count = n()) %>%
  arrange(desc(count))
```

```
## # A tibble: 38 x 2
##   model          count
##   <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
## # i 28 more rows
```

#a

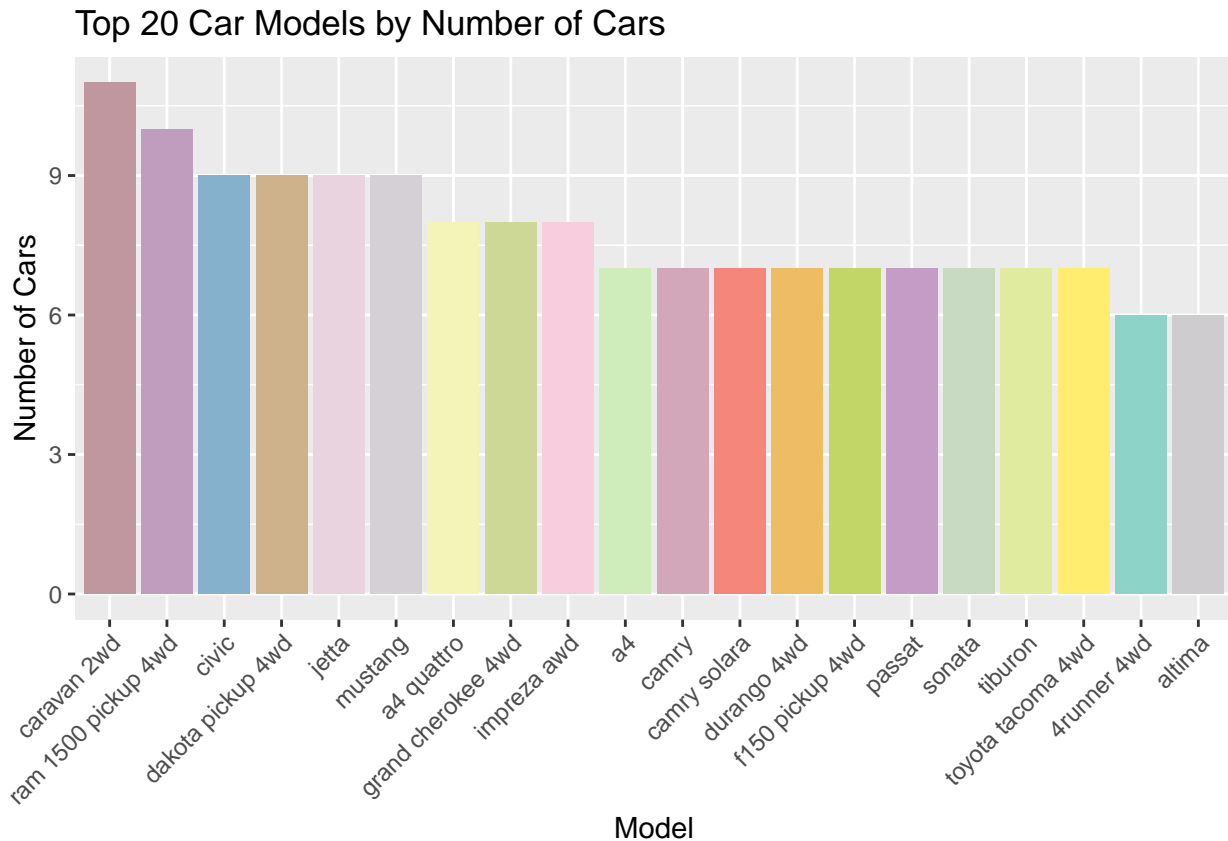
```
top_20_models <- mpg %>%
  group_by(model) %>%
```

```

summarise(count = n()) %>%
  arrange(desc(count)) %>%
  head(20)

ggplot(top_20_models, aes(x = reorder(model, -count), y = count, fill = model)) +
  geom_bar(stat = "identity") +
  xlab("Model") + ylab("Number of Cars") +
  ggtitle("Top 20 Car Models by Number of Cars") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1), legend.position = "none") +
  scale_fill_manual(values = colorRampPalette(brewer.pal(12, "Set3"))(20))

```



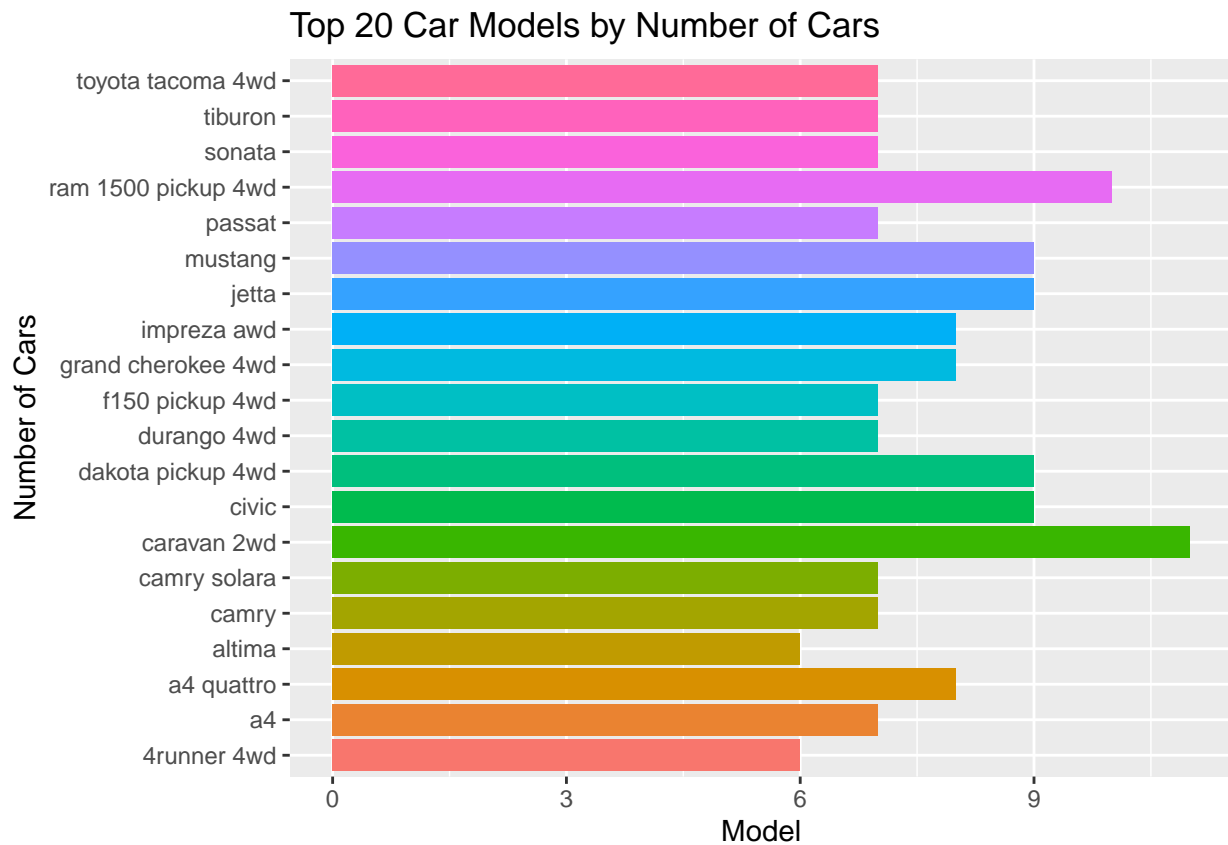
```

#b

top_20_models <- mpg %>%
  group_by(model) %>%
  summarise(count = n()) %>%
  arrange(desc(count)) %>%
  head(20)

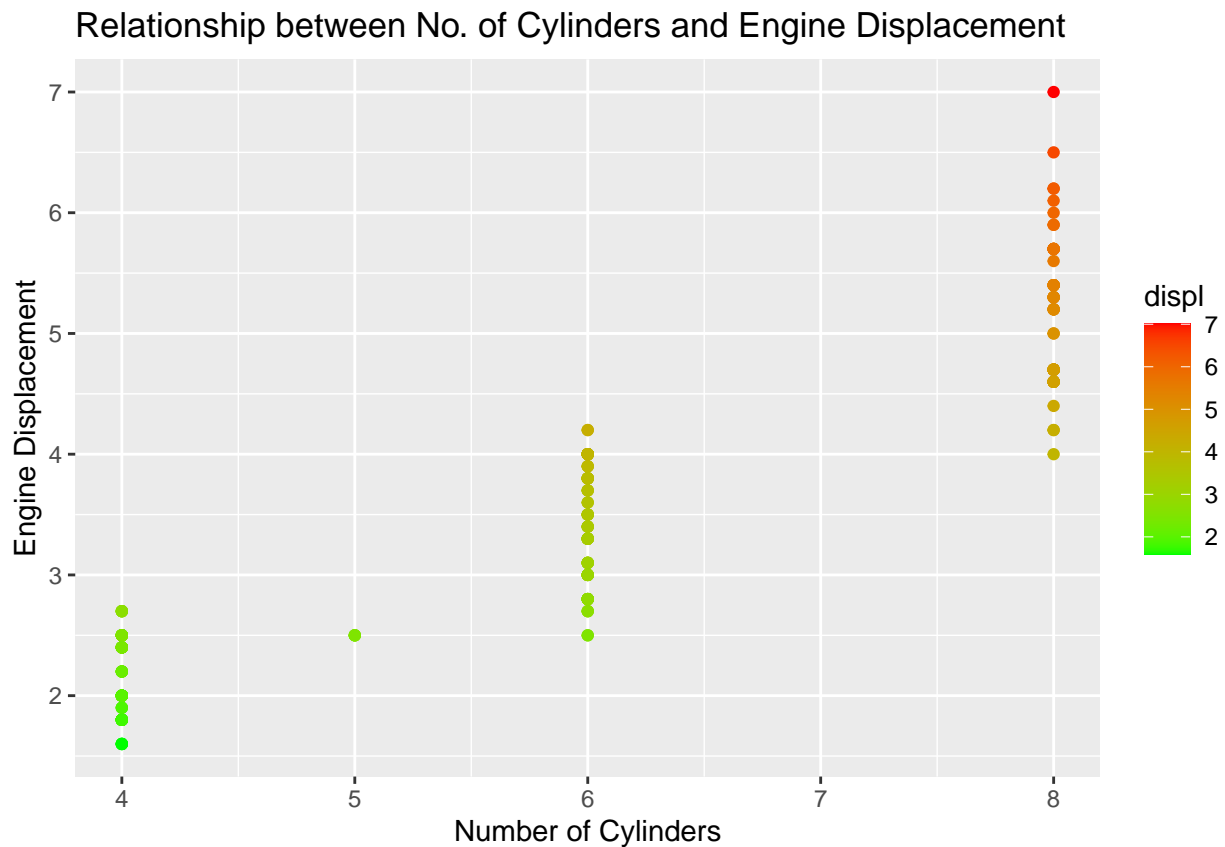
ggplot(top_20_models, aes(x = model, y = count, fill = model)) +
  geom_bar(stat = "identity") +
  coord_flip() +
  xlab("Number of Cars") + ylab("Model") +
  ggtitle("Top 20 Car Models by Number of Cars") +
  theme(axis.text.y = element_text(size = 9), legend.position = "none")

```



#5

```
ggplot(mpg, aes(x = cyl, y = displ, color = displ)) +
  geom_point() +
  ggtitle("Relationship between No. of Cylinders and Engine Displacement") +
  xlab("Number of Cylinders") + ylab("Engine Displacement") +
  scale_color_gradient(low = "green", high = "red")
```

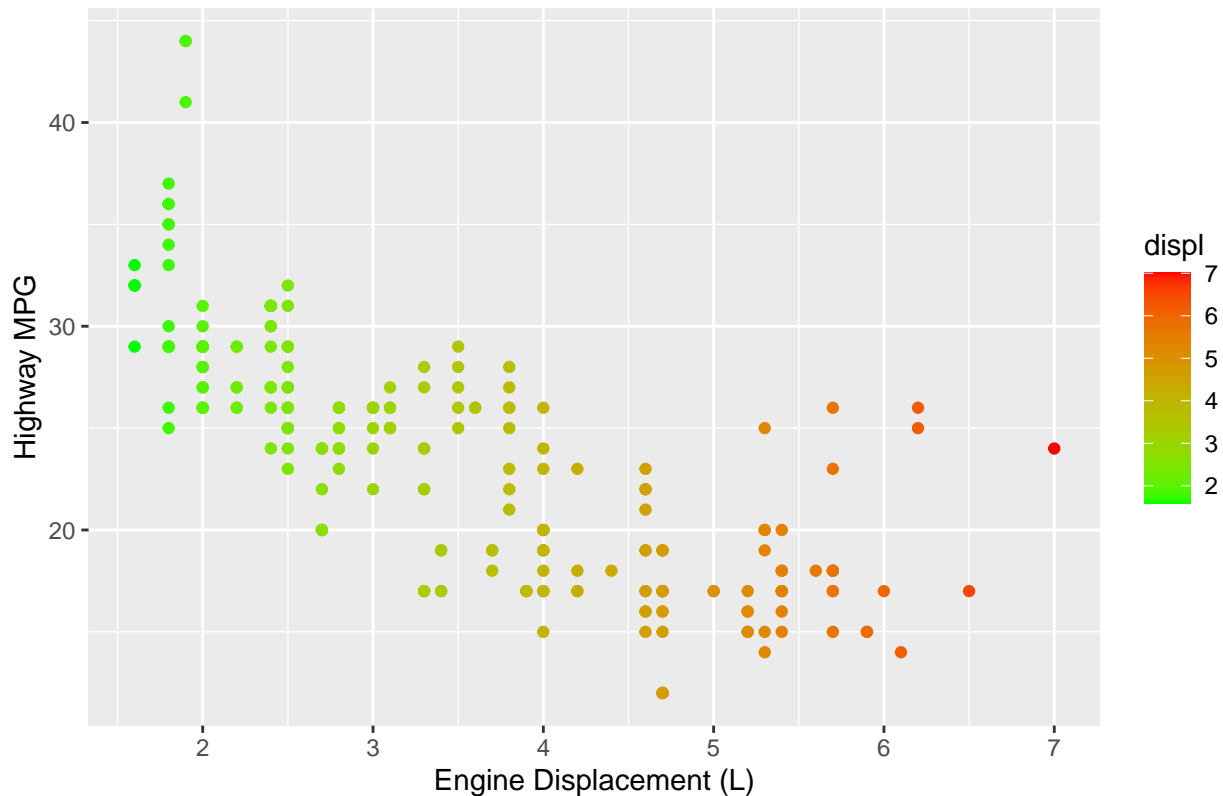
#a

#In general, engines with more cylinders have larger displacements.

#6

```
ggplot(mpg, aes(x = displ, y = hwy, color = displ)) +
  geom_point() +
  ggtitle("Relationship between Engine Displacement and Highway MPG") +
  xlab("Engine Displacement (L)") + ylab("Highway MPG") +
  scale_color_gradient(low = "green", high = "red")
```

Relationship between Engine Displacement and Highway MPG



#6

```
traffic_data <- data.frame(
  Date = as.Date('2025-11-01') + 0:9,
  Location = rep(c("Intersection A", "Intersection B"), each = 5),
  Vehicles = c(120, 150, 130, 160, 140, 200, 210, 190, 205, 220),
  Average_Speed = c(35.5, 34.2, 36.0, 33.8, 34.5, 32.0, 31.5, 33.0, 30.8, 29.5)
)
write.csv(traffic_data, "traffic.csv", row.names = FALSE)
traffic <- read.csv("traffic.csv", stringsAsFactors = FALSE)
```

#a

```
str(traffic)
```

```
## 'data.frame':    10 obs. of  4 variables:
## $ Date          : chr  "2025-11-01" "2025-11-02" "2025-11-03" "2025-11-04" ...
## $ Location       : chr  "Intersection A" "Intersection A" "Intersection A" "Intersection A" ...
## $ Vehicles       : int   120 150 130 160 140 200 210 190 205 220
## $ Average_Speed  : num   35.5 34.2 36 33.8 34.5 32 31.5 33 30.8 29.5
```

#b

```
intersection_a <- traffic[traffic$Location == "Intersection A", ]
intersection_b <- traffic[traffic$Location == "Intersection B", ]
```

```
print(intersection_a)
```

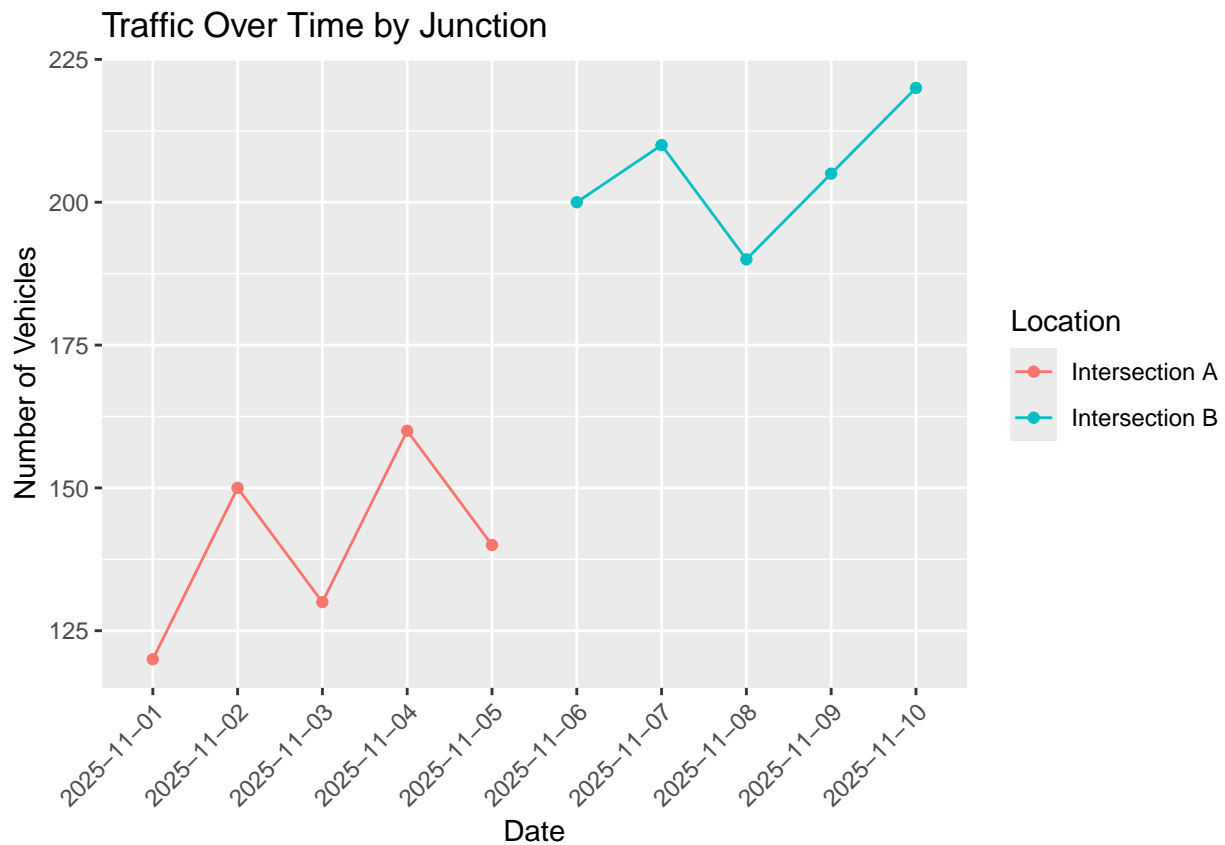
```
##           Date      Location Vehicles Average_Speed
## 1 2025-11-01 Intersection A      120          35.5
## 2 2025-11-02 Intersection A      150          34.2
## 3 2025-11-03 Intersection A      130          36.0
## 4 2025-11-04 Intersection A      160          33.8
## 5 2025-11-05 Intersection A      140          34.5
```

```
print(intersection_b)
```

```
##           Date      Location Vehicles Average_Speed
## 6 2025-11-06 Intersection B      200          32.0
## 7 2025-11-07 Intersection B      210          31.5
## 8 2025-11-08 Intersection B      190          33.0
## 9 2025-11-09 Intersection B      205          30.8
## 10 2025-11-10 Intersection B      220          29.5
```

```
#c
```

```
ggplot(traffic, aes(x = Date, y = Vehicles, color = Location, group = Location)) +  
  geom_line() +  
  geom_point() +  
  xlab("Date") + ylab("Number of Vehicles") +  
  ggtitle("Traffic Over Time by Junction") +  
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



```
#7
library(readxl)
alexa <- read_excel("alexa-file.xlsx")
```

```
#a

str(alexa)
```

```
## tibble [5 x 5] (S3: tbl_df/tbl/data.frame)
##  $ rating      : num [1:5] 5 5 5 5 5
##  $ date        : chr [1:5] "2018-07-30" "2018-07-30" "2018-07-30" "2018-07-30" ...
##  $ variation    : chr [1:5] "Black Dot" "Black Dot" "Black Dot" "White Dot" ...
##  $ verified_reviews: chr [1:5] "Good" "Pretty OK" "Great" "Lackluster" ...
##  $ feedback     : num [1:5] 1 1 1 1 1
```

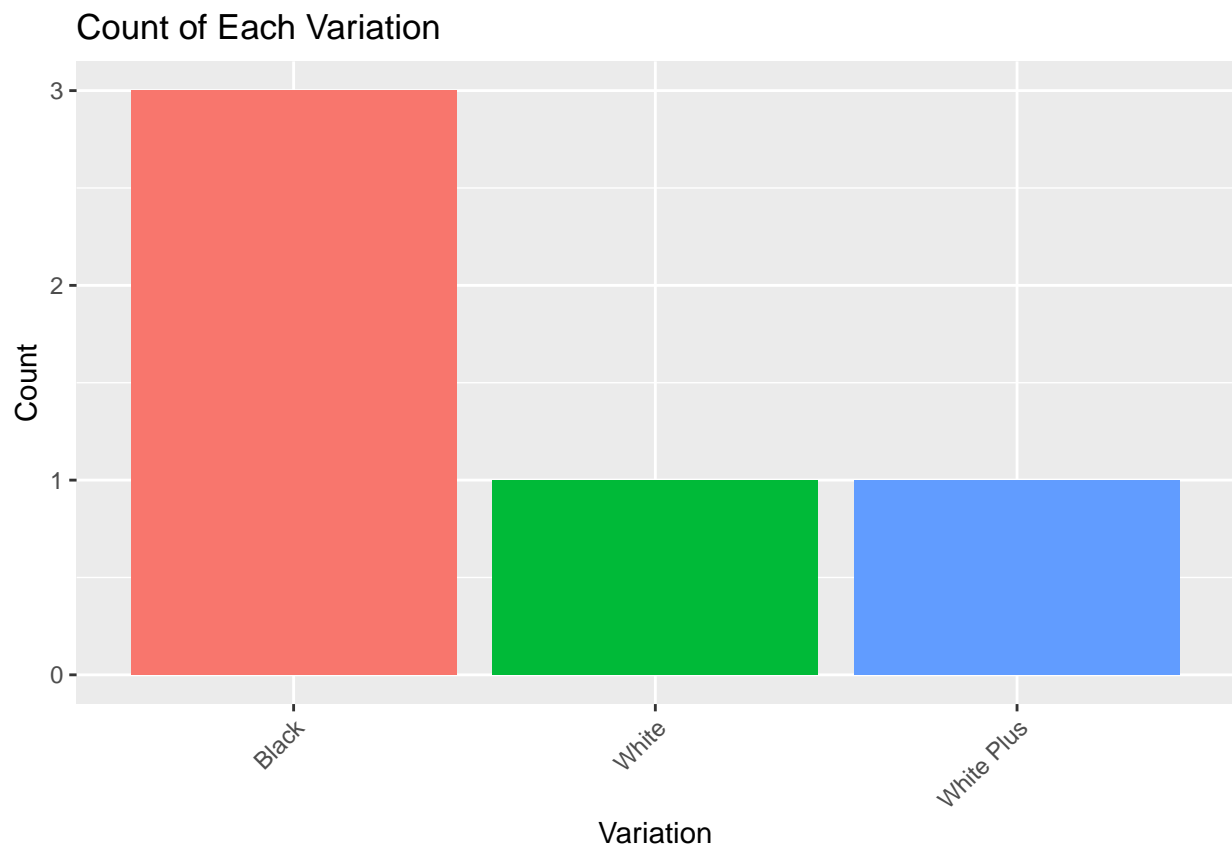
```
#b
load("variations.RData")

variations %>%
  group_by(variation) %>%
  summarise(total = sum(n))
```

```
## # A tibble: 3 x 2
##   variation total
##   <chr>      <int>
## 1 Black          3
## 2 White          1
## 3 White Plus     1
```

```
#c

ggplot(variations, aes(x = variation, y = n, fill = variation)) +
  geom_bar(stat = "identity") +
  xlab("Variation") + ylab("Count") +
  ggtitle("Count of Each Variation") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1), legend.position = "none")
```



#d

#Data = N/A

#e

#Ratings = N/A