

Work Sheet 4c

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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)
```

```
###1.
```

```
data(mpg)

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

```
#1A.
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
```

```
#1B.
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
```

```
#1C.
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
```

```
#2A.
unique_models <- mpg %>%
  group_by(manufacturer) %>%
  summarise(unique_models = n_distinct(model)) %>%
  arrange(desc(unique_models))

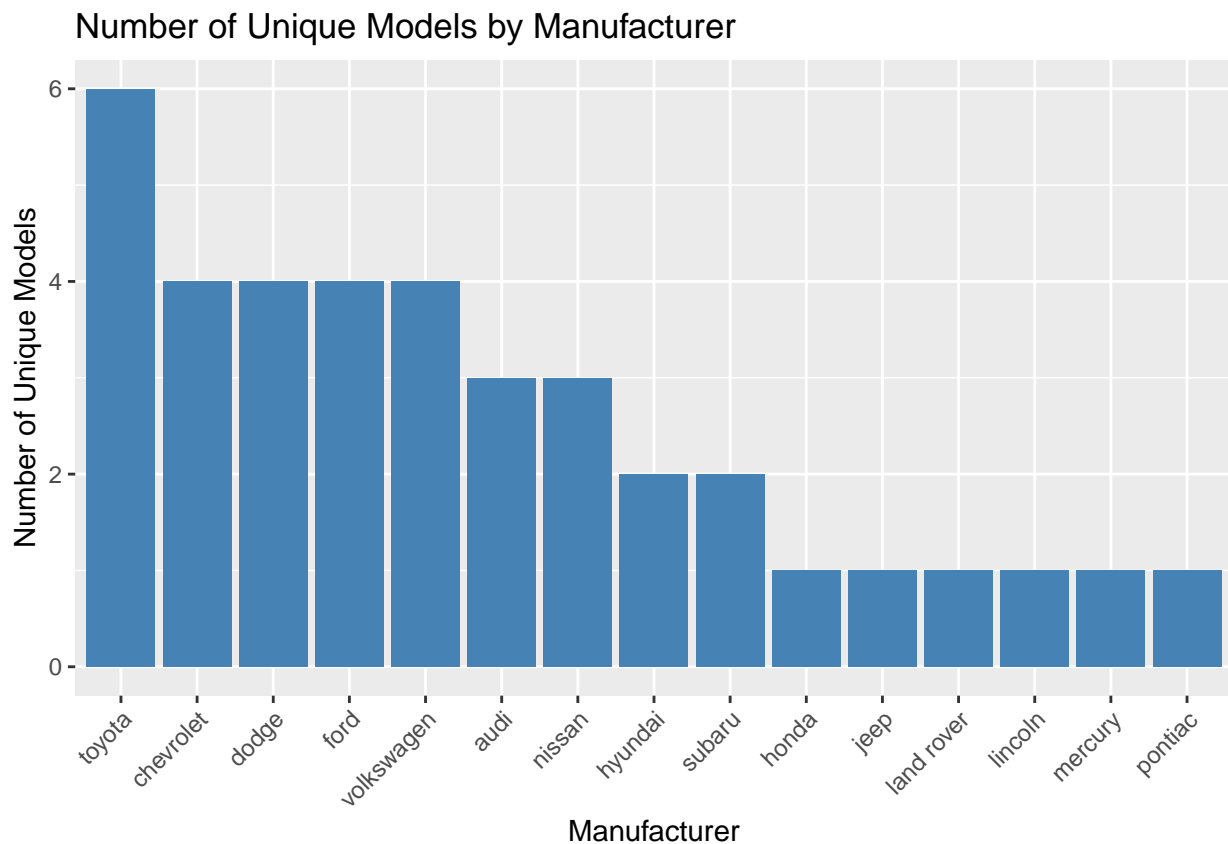
unique_models
```

```
## # 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
```

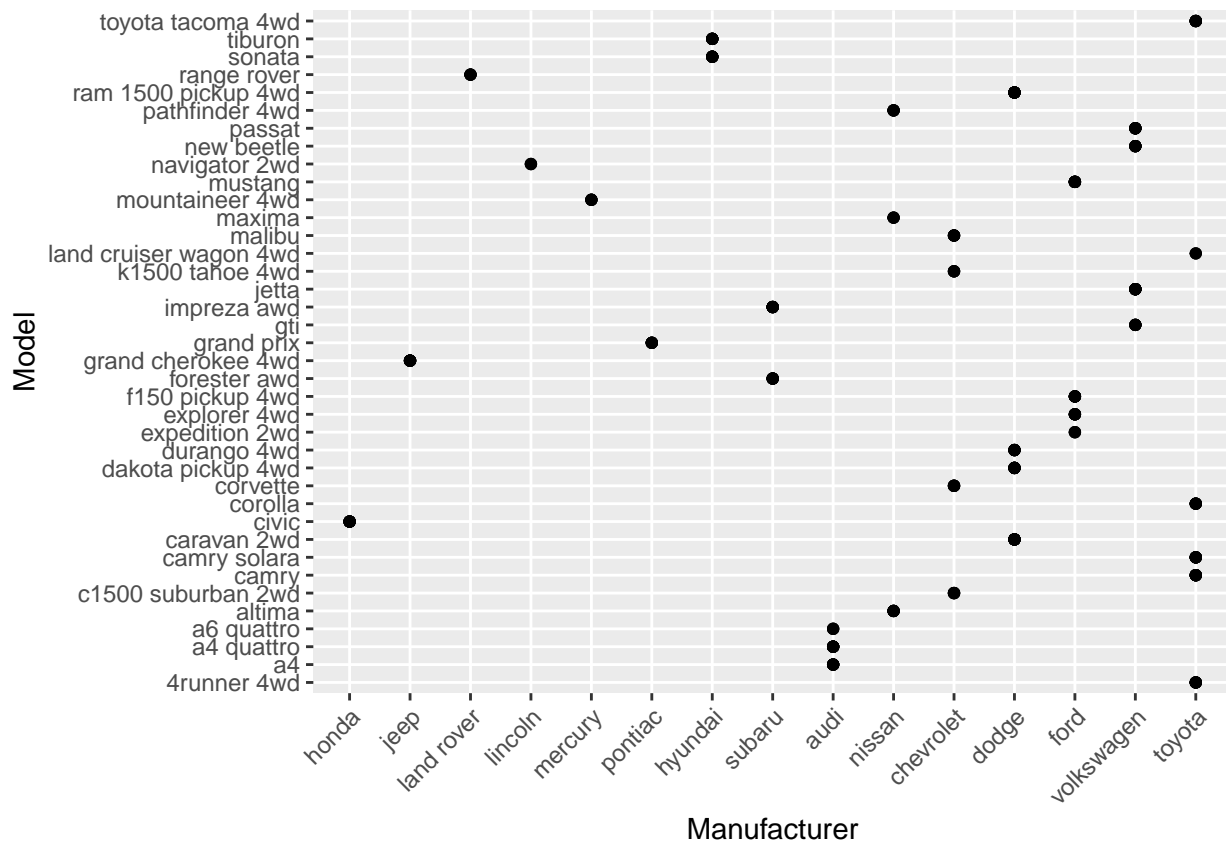
#2B.

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



#2A.

```
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))
```



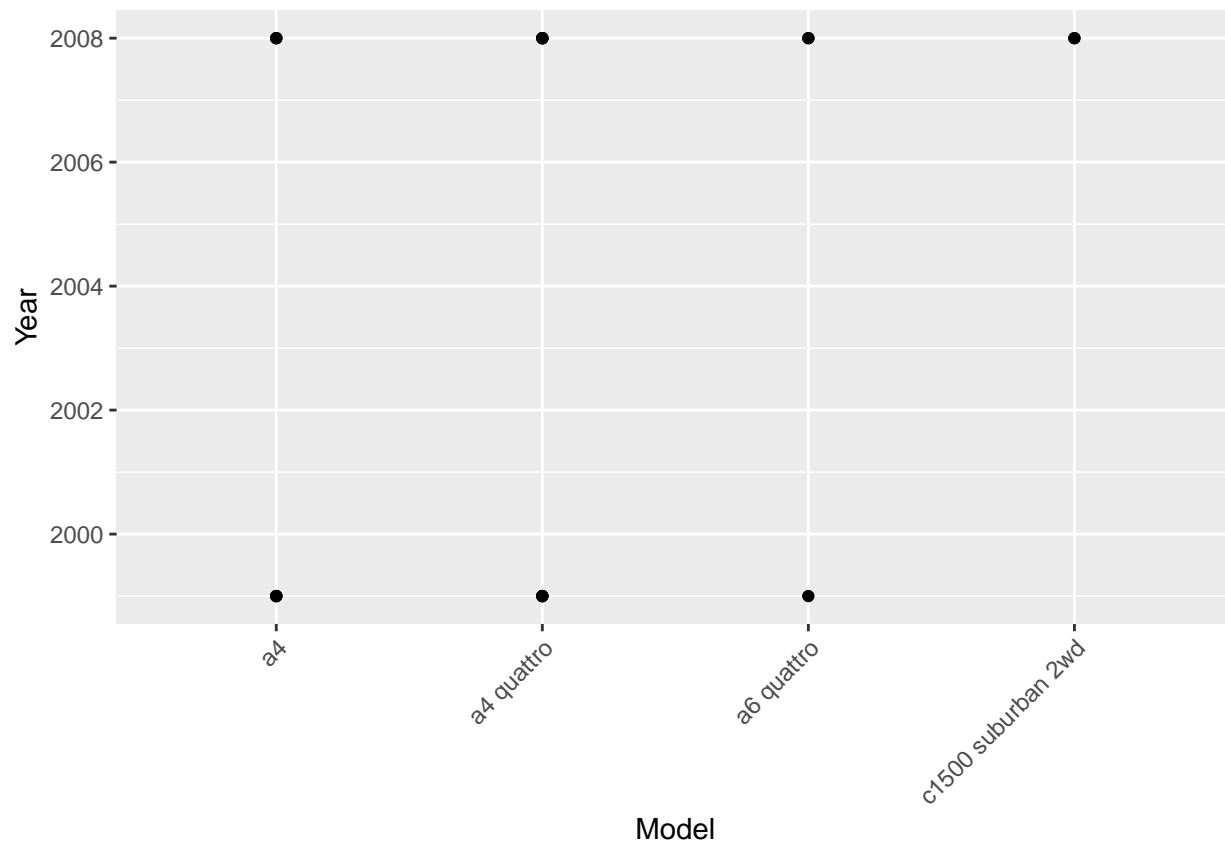
#2B.

#For me, no. Barplot is more useless and easy 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
```

#4A.

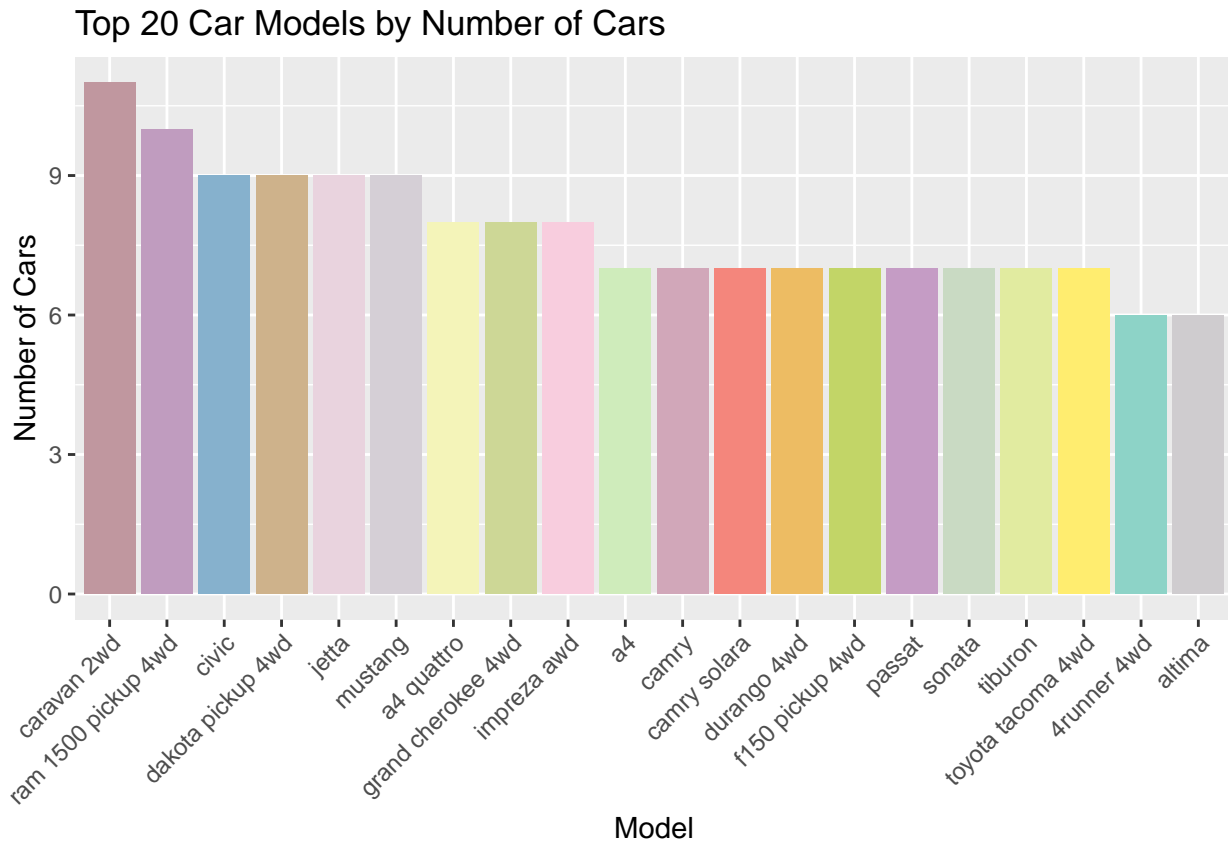
```
top_20_models <- mpg %>%
  group_by(model) %>%
```

```

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))

```



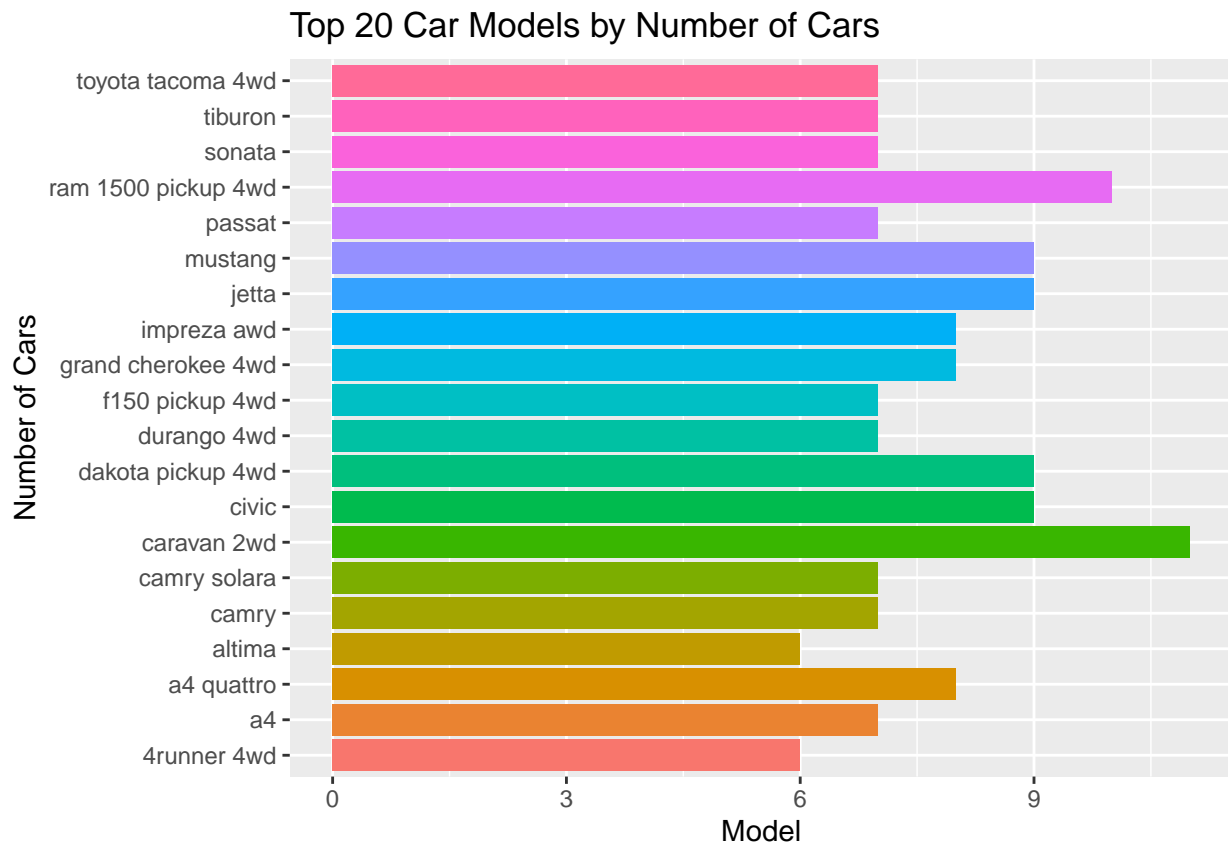
#4B.

```

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

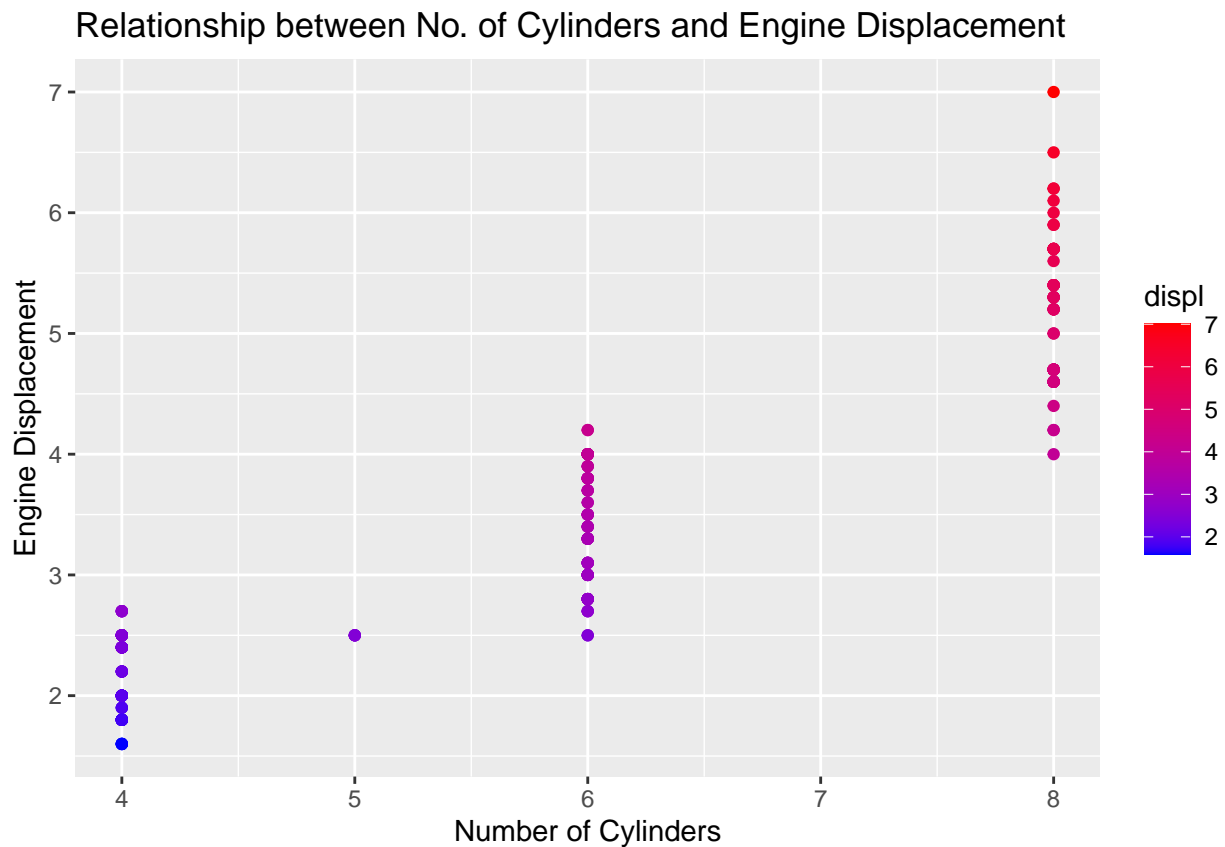
ggplot(top_20_models, aes(x = model, y = count, fill = model)) +
  geom_bar(stat = "identity") +
  coord_flip() +
  xlab("Number of Cars") + ylab("Model") +
  ggtitle("Top 20 Car Models by Number of Cars") +
  theme(axis.text.y = element_text(size = 9), legend.position = "none")

```



#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 = "blue", high = "red")
```

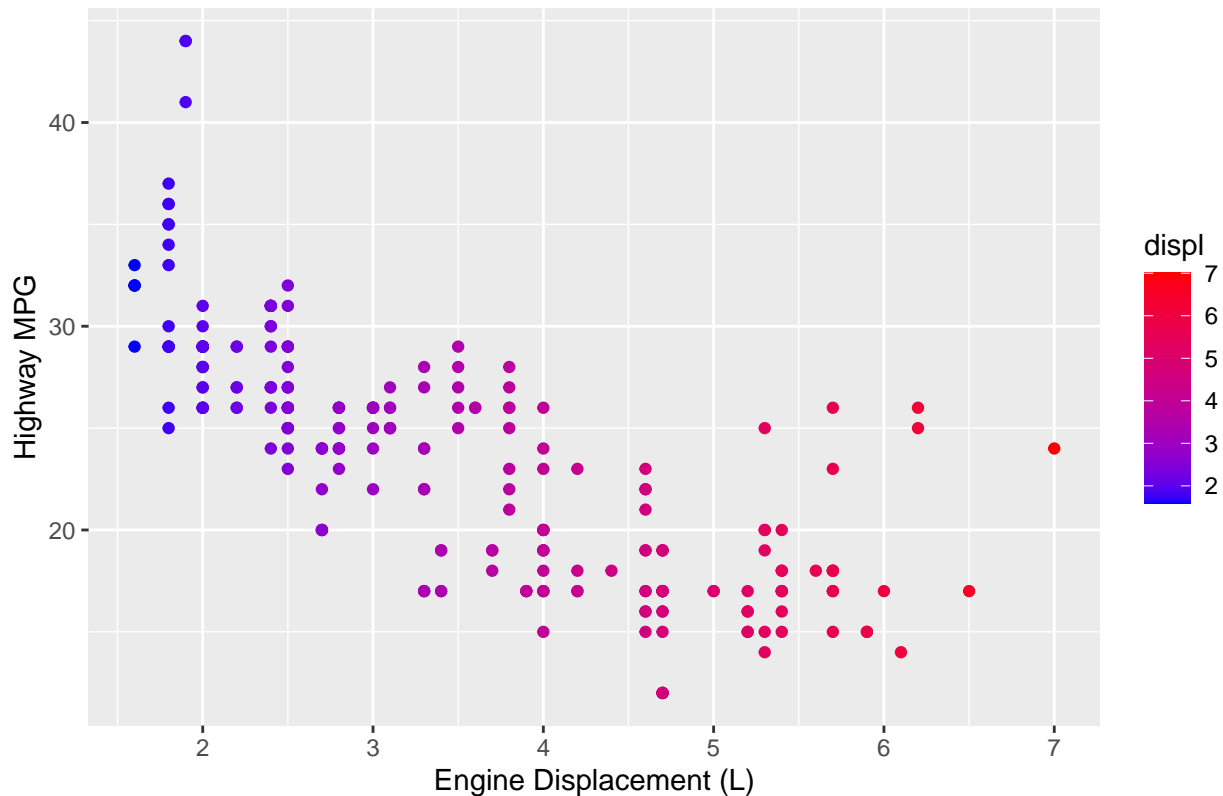
#5A.

#Is strong and positive, engines with more cylinders generally have larger displacement.

#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 = "blue", high = "red")
```

Relationship between Engine Displacement and Highway MPG



#6. I AM NOT SURE MAAM IF THE TRAFFIC DATA SET IS CORRECT, I HAVE NO IDEA WHERE TO GET THE DATA

```
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)
```

#6A.

```
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
```

#6B.

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

```
intersection_b <- traffic[traffic$Location == "Intersection B", ]
print(intersection_a)
```

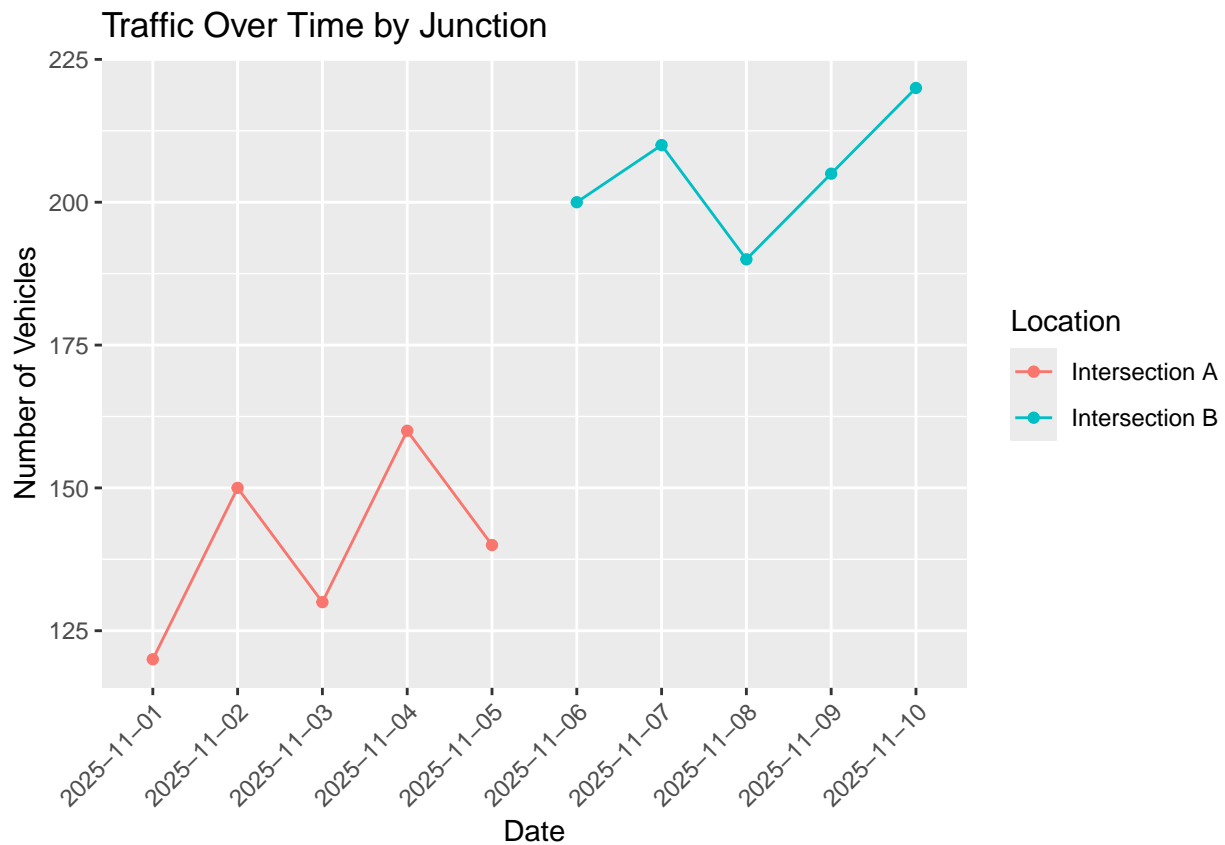
```
##           Date      Location Vehicles Average_Speed
## 1 2025-11-01 Intersection A      120          35.5
## 2 2025-11-02 Intersection A      150          34.2
## 3 2025-11-03 Intersection A      130          36.0
## 4 2025-11-04 Intersection A      160          33.8
## 5 2025-11-05 Intersection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

#6C.

```
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.

```
alexu <- read_excel("alexu-file.xlsx")
```

#7A.

```
str(alexu)
```

```
## tibble [8 x 5] (S3: tbl_df/tbl/data.frame)
## $ rating      : num [1:8] 5 5 4 3 5 4 5 4
## $ date        : chr [1:8] "2018-07-30" "2018-07-30" "2018-07-30" "2018-07-30" ...
## $ variation    : chr [1:8] "Black Dot" "Black Plus" "Black Show" "Black Spot" ...
## $ verified_reviews: chr [1:8] "It works great!!" "PHENOMENAL" "I used it to control my smart devices" ...
## $ feedback     : num [1:8] 1 1 1 1 1 1 1 1
```

#7B.

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

```
numeric_col <- names(variations)[sapply(variations, is.numeric)][1]
```

```
variations %>%
  group_by(variation) %>%
  summarise(total = sum(.data[[numeric_col]]))
```

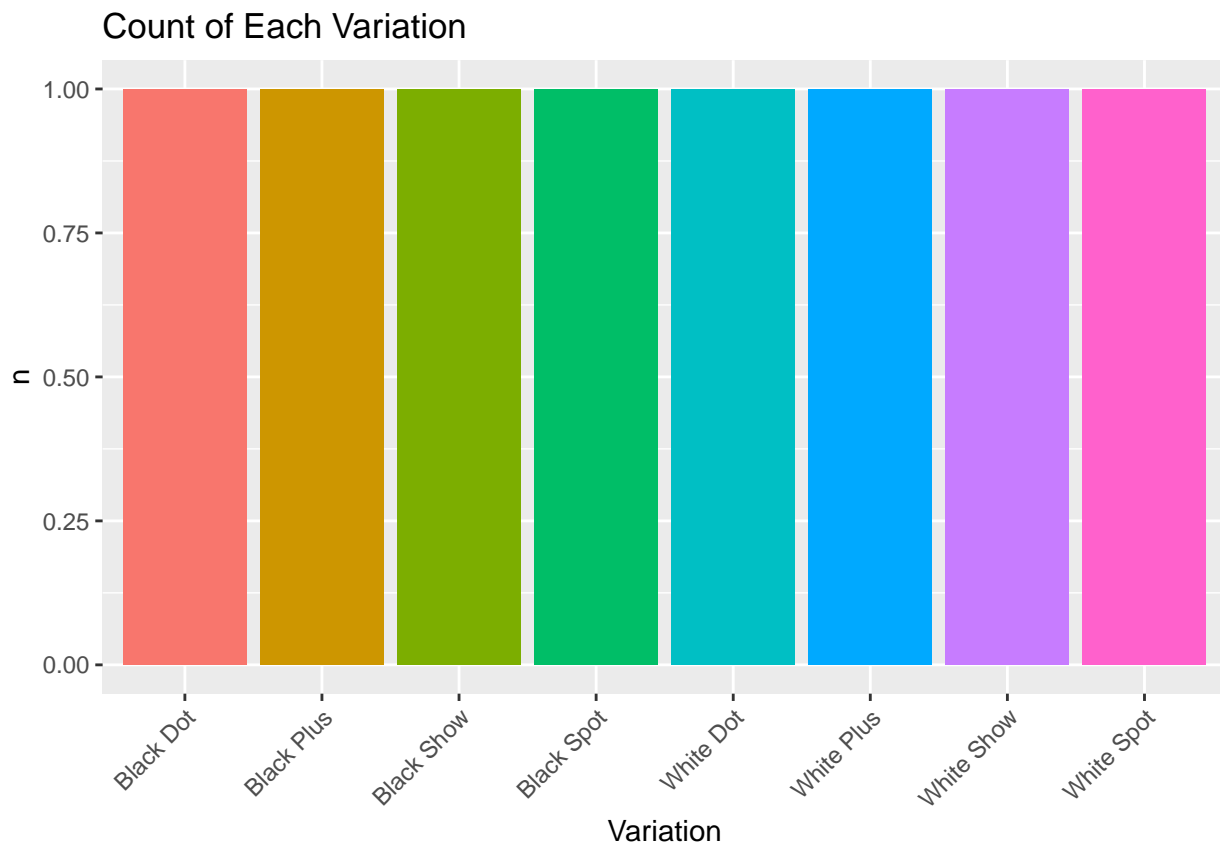
```
## # A tibble: 8 x 2
##   variation total
```

```
##   <chr>      <int>
## 1 Black Dot    1
## 2 Black Plus   1
## 3 Black Show   1
## 4 Black Spot   1
## 5 White Dot    1
## 6 White Plus   1
## 7 White Show   1
## 8 White Spot   1
```

#7C.

```
num_col <- names(variations)[sapply(variations, is.numeric)][1]

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



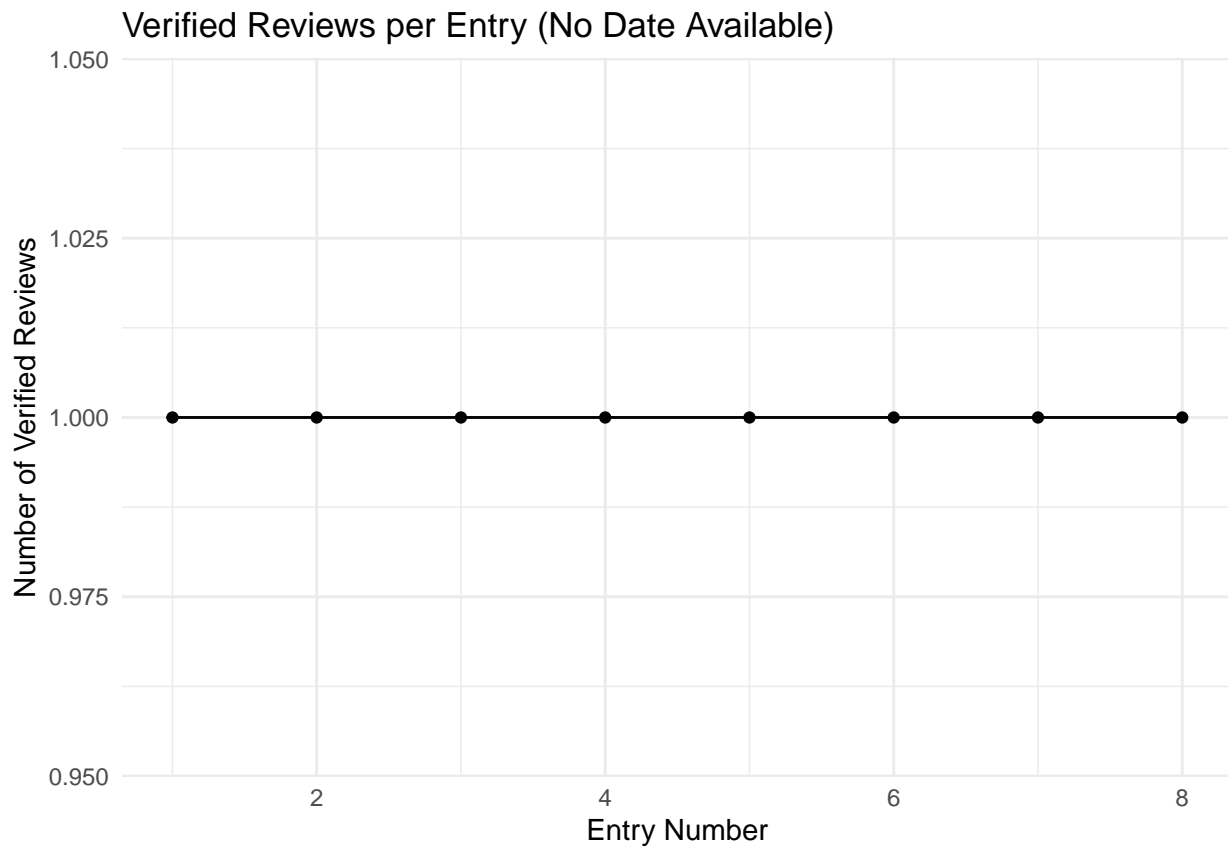
#7D.

```
num_col <- names(variations)[sapply(variations, is.numeric)][1]

variations$index <- 1:nrow(variations)

ggplot(variations, aes(x = index, y = .data[[num_col]])) +
```

```
geom_line() +
geom_point() +
xlab("Entry Number") +
ylab("Number of Verified Reviews") +
ggtitle("Verified Reviews per Entry (No Date Available)") +
theme_minimal()
```



#My variations dataset has no date, so I used the entry number as a substitute to create the line plot.

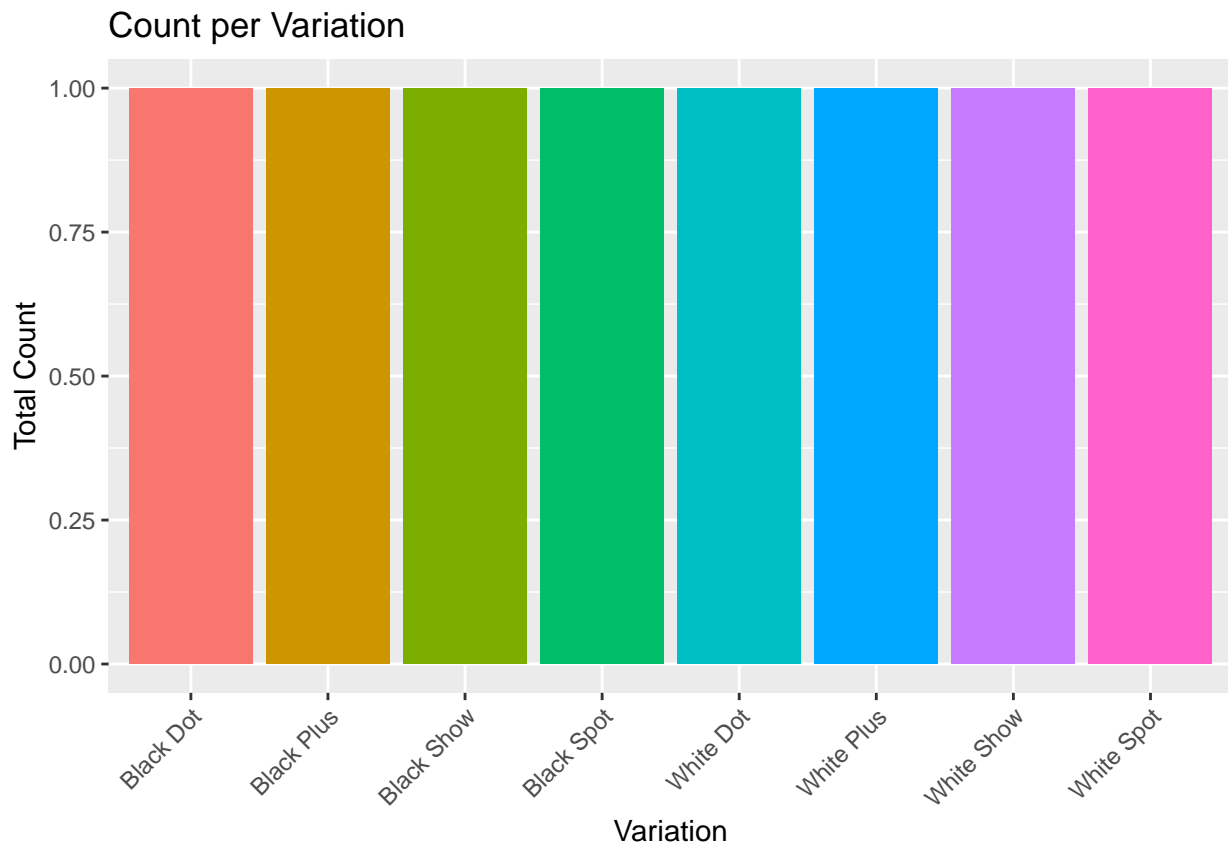
```
#7E.
variation_col <- names(variations)[sapply(variations, is.character) | sapply(variations, is.factor)][1]
num_col <- names(variations)[sapply(variations, is.numeric)][1]

variation_summary <- variations %>%
  group_by(.data[[variation_col]]) %>%
  summarise(total = sum(.data[[num_col]], na.rm = TRUE))

variation_summary %>% arrange(desc(total)) %>% head(1)
```

```
## # A tibble: 1 x 2
##   variation total
##   <chr>      <int>
## 1 Black Dot      1
```

```
ggplot(variation_summary,
       aes(x = .data[[variation_col]], y = total, fill = .data[[variation_col]])) +
  geom_col() +
  xlab("Variation") +
  ylab("Total Count") +
  ggtitle("Count per Variation") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1),
        legend.position = "none")
```



#My variations dataset has no ratings, so I used the count values instead to identify which variation h