

Class 5 Data Visual with ggplot2

Destiny (A16340362)

```
##Using ggplot
```

The ggplot2 package needs to be installed as it doesn't come with R "out of the box."

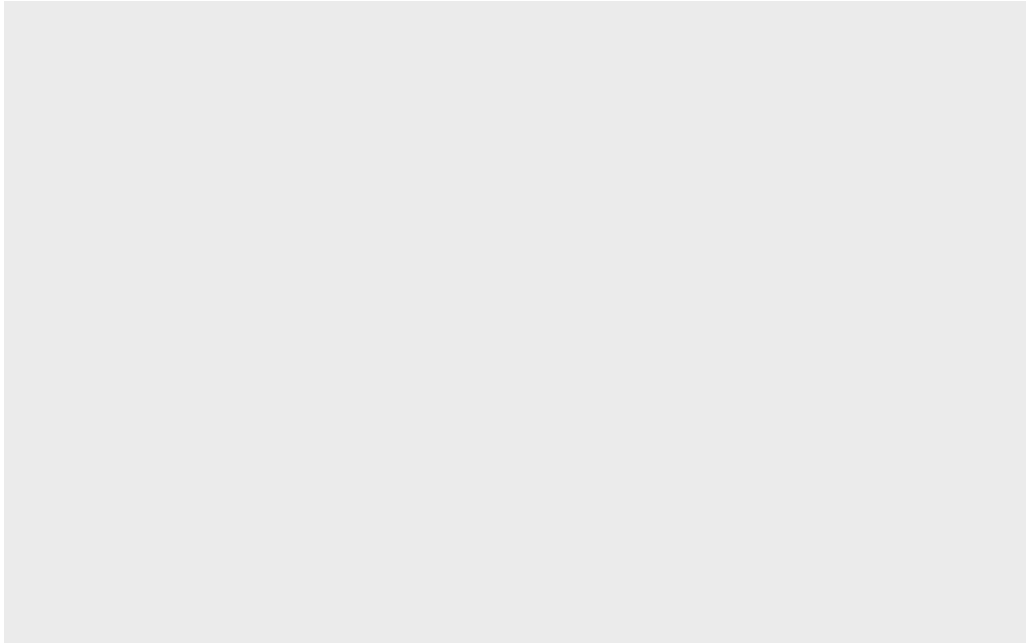
We use the `install.packages()` function to do this.

```
head(cars)
```

	speed	dist
1	4	2
2	4	10
3	7	4
4	7	22
5	8	16
6	9	10

To use ggplot, I need to load it up before I can call any of the functions in the package. I do this with the `library()` function.

```
library(ggplot2)  
ggplot()
```



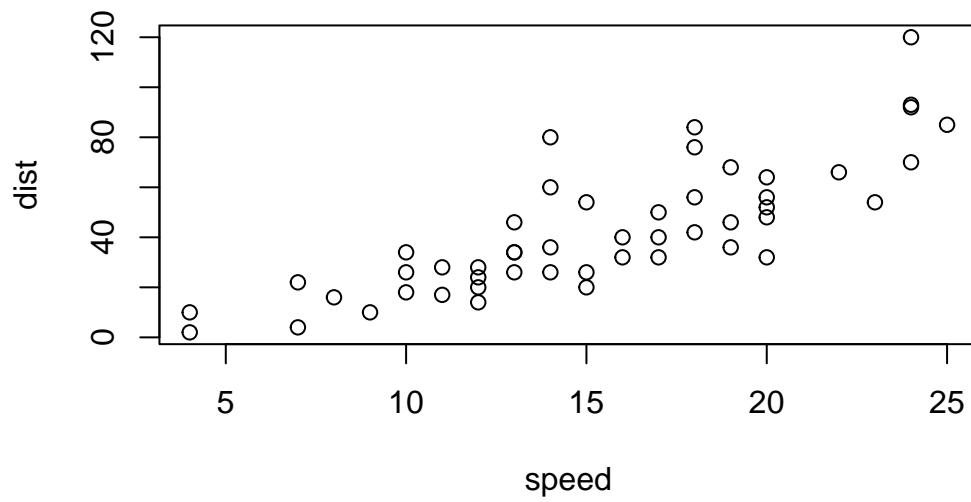
ALL ggplot figures have at least 3 things: -data(the stuff we want to plot) -aesthetic mapping (aes values) -geometry (geom)

```
ggplot(cars)+  
  aes(x=speed, y=dist) +  
  geom_point()
```



ggplot is not the only graphing system in R, there are a lot of others. There is even “base R” graphics

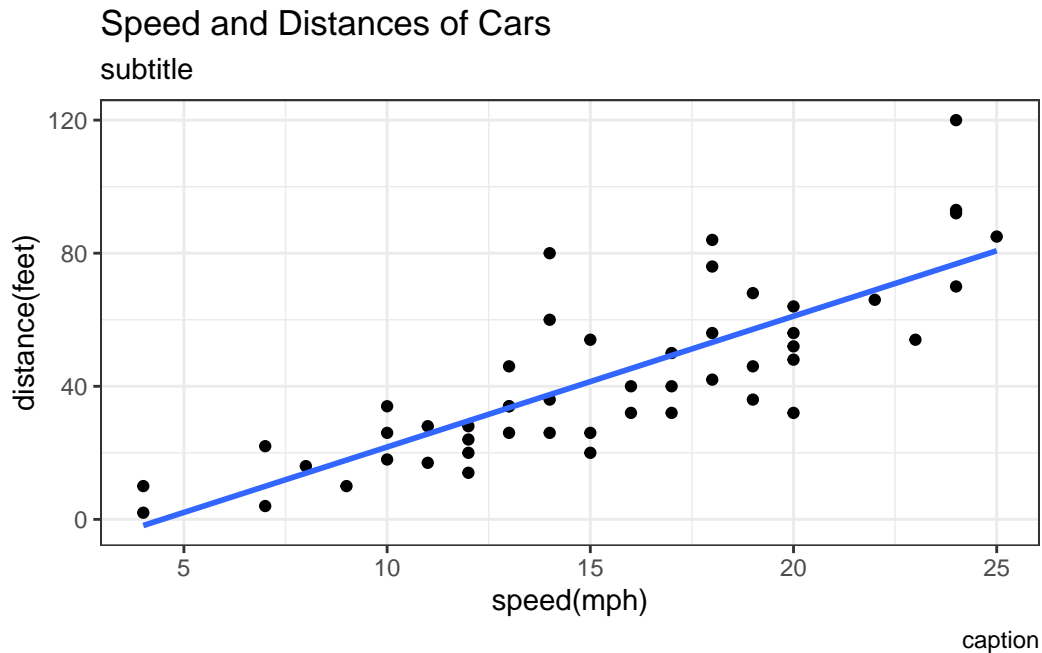
```
plot(cars)
```



```
ggplot(cars) ggplot(cars)+ aes(x=speed, y=dist)
```

```
ggplot(cars)+  
  aes(x=speed, y=dist) +  
  geom_point() +  
  geom_smooth(method="lm", se=FALSE) +  
  labs(title = "Speed and Distances of Cars", caption= "caption", subtitle = "subtitle", x=  
  theme_bw()
```

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



```
url <- "https://bioboot.github.io/bimm143_S20/class-material/up_down_expression.txt"
genes <- read.delim(url)
head(genes)
```

	Gene	Condition1	Condition2	State
1	A4GNT	-3.6808610	-3.4401355	unchanging
2	AAAS	4.5479580	4.3864126	unchanging
3	AASDH	3.7190695	3.4787276	unchanging
4	AATF	5.0784720	5.0151916	unchanging
5	AATK	0.4711421	0.5598642	unchanging
6	AB015752.4	-3.6808610	-3.5921390	unchanging

```
nrow(genes)
```

```
[1] 5196
```

```
colnames(genes)
```

```
[1] "Gene" "Condition1" "Condition2" "State"
```

```
ncol(genes)
```

```
[1] 4
```

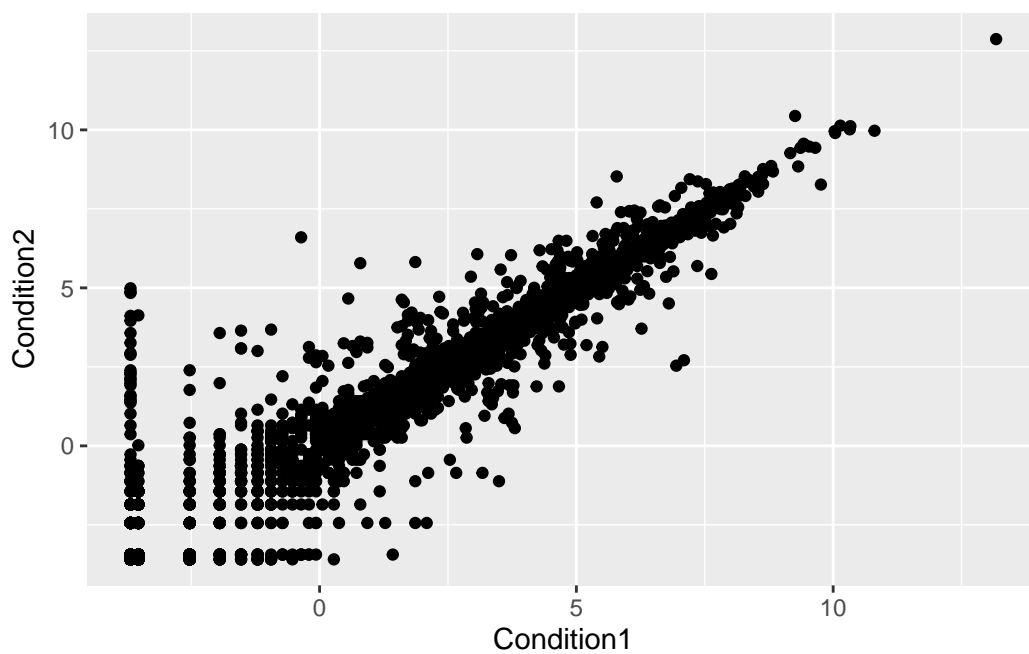
```
table(genes$State)
```

```
down  unchanged      up
    72      4997     127
```

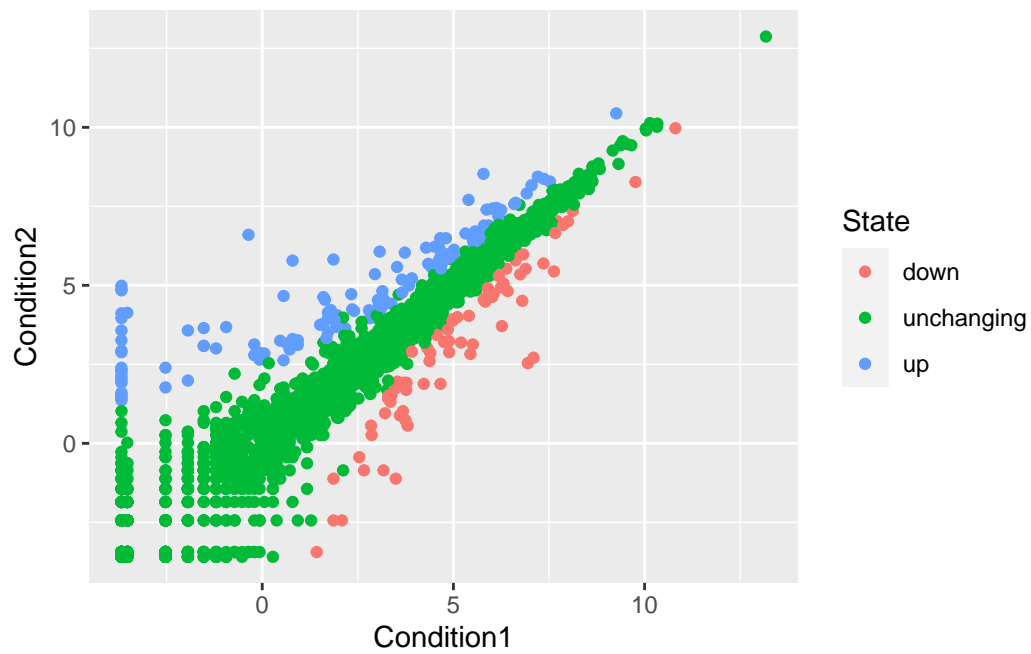
```
round(table(genes$State)/nrow(genes)*100, 2)
```

```
down  unchanged      up
  1.39      96.17     2.44
```

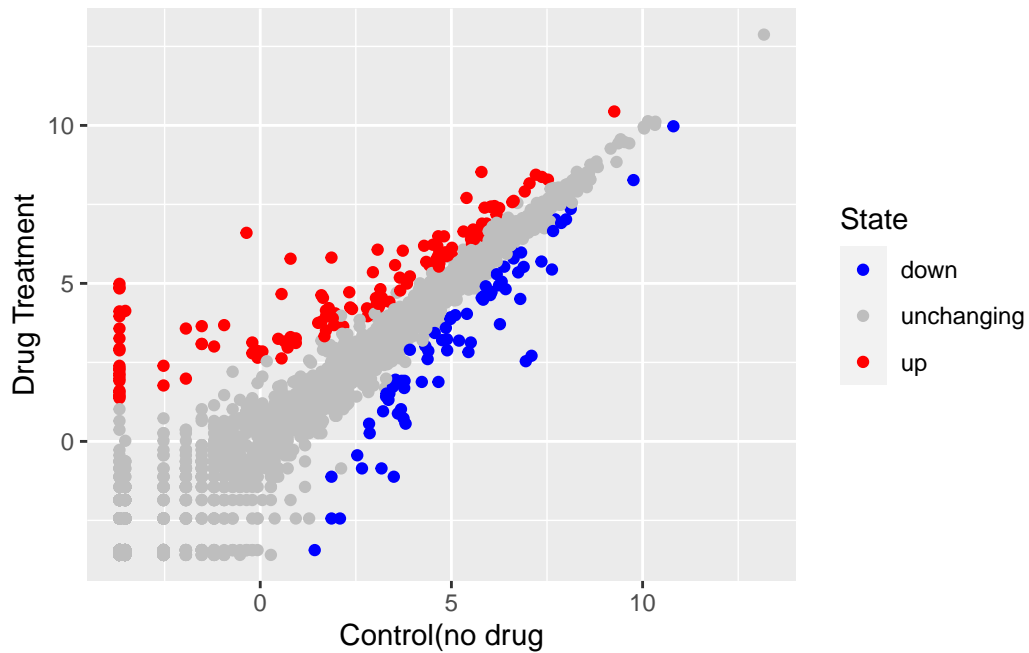
```
ggplot(genes) +  
  aes(x=Condition1, y=Condition2) +  
  geom_point()
```



```
p <- ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point()
p
```



```
p + scale_colour_manual( values=c("blue","gray","red") )+labs(y="Drug Treatment", x="Contr
```



```
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

```
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.
gapminder <- read.delim(url)
gapminder_2007 <- gapminder %>% filter(year==2007)
gapminder_2007
```

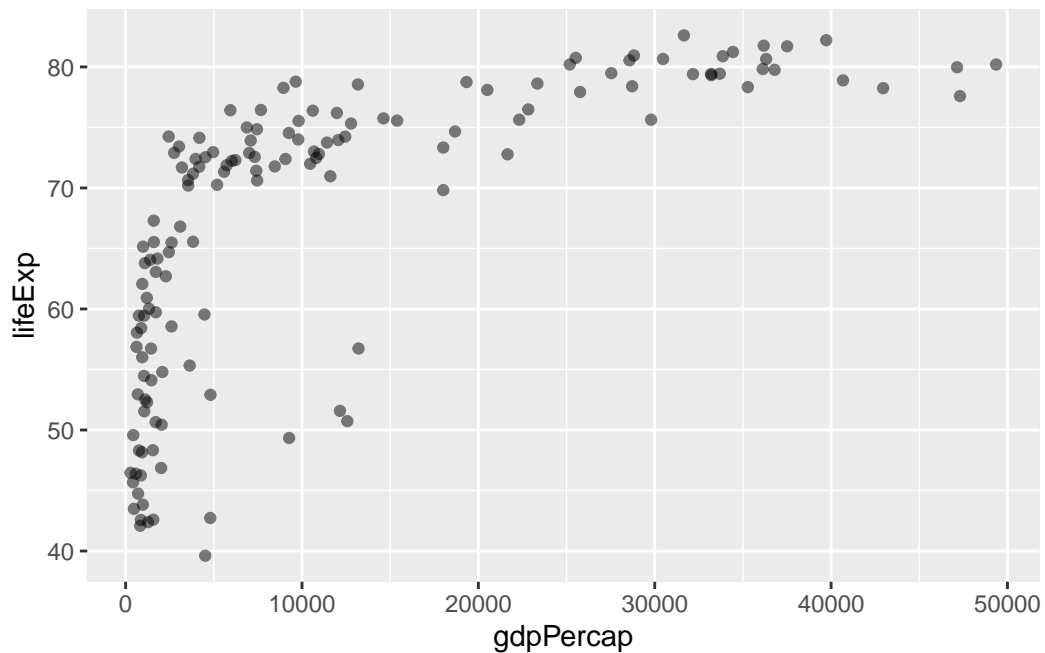

	country	continent	year	lifeExp	pop	gdpPercap
1	Afghanistan	Asia	2007	43.828	31889923	974.5803
2	Albania	Europe	2007	76.423	3600523	5937.0295
3	Algeria	Africa	2007	72.301	33333216	6223.3675
4	Angola	Africa	2007	42.731	12420476	4797.2313
5	Argentina	Americas	2007	75.320	40301927	12779.3796
6	Australia	Oceania	2007	81.235	20434176	34435.3674
7	Austria	Europe	2007	79.829	8199783	36126.4927
8	Bahrain	Asia	2007	75.635	708573	29796.0483
9	Bangladesh	Asia	2007	64.062	150448339	1391.2538
10	Belgium	Europe	2007	79.441	10392226	33692.6051
11	Benin	Africa	2007	56.728	8078314	1441.2849
12	Bolivia	Americas	2007	65.554	9119152	3822.1371
13	Bosnia and Herzegovina	Europe	2007	74.852	4552198	7446.2988
14	Botswana	Africa	2007	50.728	1639131	12569.8518
15	Brazil	Americas	2007	72.390	190010647	9065.8008
16	Bulgaria	Europe	2007	73.005	7322858	10680.7928
17	Burkina Faso	Africa	2007	52.295	14326203	1217.0330
18	Burundi	Africa	2007	49.580	8390505	430.0707
19	Cambodia	Asia	2007	59.723	14131858	1713.7787
20	Cameroon	Africa	2007	50.430	17696293	2042.0952
21	Canada	Americas	2007	80.653	33390141	36319.2350
22	Central African Republic	Africa	2007	44.741	4369038	706.0165
23	Chad	Africa	2007	50.651	10238807	1704.0637
24	Chile	Americas	2007	78.553	16284741	13171.6388
25	China	Asia	2007	72.961	1318683096	4959.1149
26	Colombia	Americas	2007	72.889	44227550	7006.5804
27	Comoros	Africa	2007	65.152	710960	986.1479
28	Congo, Dem. Rep.	Africa	2007	46.462	64606759	277.5519
29	Congo, Rep.	Africa	2007	55.322	3800610	3632.5578
30	Costa Rica	Americas	2007	78.782	4133884	9645.0614
31	Cote d'Ivoire	Africa	2007	48.328	18013409	1544.7501
32	Croatia	Europe	2007	75.748	4493312	14619.2227
33	Cuba	Americas	2007	78.273	11416987	8948.1029
34	Czech Republic	Europe	2007	76.486	10228744	22833.3085
35	Denmark	Europe	2007	78.332	5468120	35278.4187
36	Djibouti	Africa	2007	54.791	496374	2082.4816
37	Dominican Republic	Americas	2007	72.235	9319622	6025.3748
38	Ecuador	Americas	2007	74.994	13755680	6873.2623
39	Egypt	Africa	2007	71.338	80264543	5581.1810
40	El Salvador	Americas	2007	71.878	6939688	5728.3535
41	Equatorial Guinea	Africa	2007	51.579	551201	12154.0897
42	Eritrea	Africa	2007	58.040	4906585	641.3695

43	Ethiopia	Africa	2007	52.947	76511887	690.8056
44	Finland	Europe	2007	79.313	5238460	33207.0844
45	France	Europe	2007	80.657	61083916	30470.0167
46	Gabon	Africa	2007	56.735	1454867	13206.4845
47	Gambia	Africa	2007	59.448	1688359	752.7497
48	Germany	Europe	2007	79.406	82400996	32170.3744
49	Ghana	Africa	2007	60.022	22873338	1327.6089
50	Greece	Europe	2007	79.483	10706290	27538.4119
51	Guatemala	Americas	2007	70.259	12572928	5186.0500
52	Guinea	Africa	2007	56.007	9947814	942.6542
53	Guinea-Bissau	Africa	2007	46.388	1472041	579.2317
54	Haiti	Americas	2007	60.916	8502814	1201.6372
55	Honduras	Americas	2007	70.198	7483763	3548.3308
56	Hong Kong, China	Asia	2007	82.208	6980412	39724.9787
57	Hungary	Europe	2007	73.338	9956108	18008.9444
58	Iceland	Europe	2007	81.757	301931	36180.7892
59	India	Asia	2007	64.698	1110396331	2452.2104
60	Indonesia	Asia	2007	70.650	223547000	3540.6516
61	Iran	Asia	2007	70.964	69453570	11605.7145
62	Iraq	Asia	2007	59.545	27499638	4471.0619
63	Ireland	Europe	2007	78.885	4109086	40675.9964
64	Israel	Asia	2007	80.745	6426679	25523.2771
65	Italy	Europe	2007	80.546	58147733	28569.7197
66	Jamaica	Americas	2007	72.567	2780132	7320.8803
67	Japan	Asia	2007	82.603	127467972	31656.0681
68	Jordan	Asia	2007	72.535	6053193	4519.4612
69	Kenya	Africa	2007	54.110	35610177	1463.2493
70	Korea, Dem. Rep.	Asia	2007	67.297	23301725	1593.0655
71	Korea, Rep.	Asia	2007	78.623	49044790	23348.1397
72	Kuwait	Asia	2007	77.588	2505559	47306.9898
73	Lebanon	Asia	2007	71.993	3921278	10461.0587
74	Lesotho	Africa	2007	42.592	2012649	1569.3314
75	Liberia	Africa	2007	45.678	3193942	414.5073
76	Libya	Africa	2007	73.952	6036914	12057.4993
77	Madagascar	Africa	2007	59.443	19167654	1044.7701
78	Malawi	Africa	2007	48.303	13327079	759.3499
79	Malaysia	Asia	2007	74.241	24821286	12451.6558
80	Mali	Africa	2007	54.467	12031795	1042.5816
81	Mauritania	Africa	2007	64.164	3270065	1803.1515
82	Mauritius	Africa	2007	72.801	1250882	10956.9911
83	Mexico	Americas	2007	76.195	108700891	11977.5750
84	Mongolia	Asia	2007	66.803	2874127	3095.7723
85	Montenegro	Europe	2007	74.543	684736	9253.8961

86	Morocco	Africa	2007	71.164	33757175	3820.1752
87	Mozambique	Africa	2007	42.082	19951656	823.6856
88	Myanmar	Asia	2007	62.069	47761980	944.0000
89	Namibia	Africa	2007	52.906	2055080	4811.0604
90	Nepal	Asia	2007	63.785	28901790	1091.3598
91	Netherlands	Europe	2007	79.762	16570613	36797.9333
92	New Zealand	Oceania	2007	80.204	4115771	25185.0091
93	Nicaragua	Americas	2007	72.899	5675356	2749.3210
94	Niger	Africa	2007	56.867	12894865	619.6769
95	Nigeria	Africa	2007	46.859	135031164	2013.9773
96	Norway	Europe	2007	80.196	4627926	49357.1902
97	Oman	Asia	2007	75.640	3204897	22316.1929
98	Pakistan	Asia	2007	65.483	169270617	2605.9476
99	Panama	Americas	2007	75.537	3242173	9809.1856
100	Paraguay	Americas	2007	71.752	6667147	4172.8385
101	Peru	Americas	2007	71.421	28674757	7408.9056
102	Philippines	Asia	2007	71.688	91077287	3190.4810
103	Poland	Europe	2007	75.563	38518241	15389.9247
104	Portugal	Europe	2007	78.098	10642836	20509.6478
105	Puerto Rico	Americas	2007	78.746	3942491	19328.7090
106	Reunion	Africa	2007	76.442	798094	7670.1226
107	Romania	Europe	2007	72.476	22276056	10808.4756
108	Rwanda	Africa	2007	46.242	8860588	863.0885
109	Sao Tome and Principe	Africa	2007	65.528	199579	1598.4351
110	Saudi Arabia	Asia	2007	72.777	27601038	21654.8319
111	Senegal	Africa	2007	63.062	12267493	1712.4721
112	Serbia	Europe	2007	74.002	10150265	9786.5347
113	Sierra Leone	Africa	2007	42.568	6144562	862.5408
114	Singapore	Asia	2007	79.972	4553009	47143.1796
115	Slovak Republic	Europe	2007	74.663	5447502	18678.3144
116	Slovenia	Europe	2007	77.926	2009245	25768.2576
117	Somalia	Africa	2007	48.159	9118773	926.1411
118	South Africa	Africa	2007	49.339	43997828	9269.6578
119	Spain	Europe	2007	80.941	40448191	28821.0637
120	Sri Lanka	Asia	2007	72.396	20378239	3970.0954
121	Sudan	Africa	2007	58.556	42292929	2602.3950
122	Swaziland	Africa	2007	39.613	1133066	4513.4806
123	Sweden	Europe	2007	80.884	9031088	33859.7484
124	Switzerland	Europe	2007	81.701	7554661	37506.4191
125	Syria	Asia	2007	74.143	19314747	4184.5481
126	Taiwan	Asia	2007	78.400	23174294	28718.2768
127	Tanzania	Africa	2007	52.517	38139640	1107.4822
128	Thailand	Asia	2007	70.616	65068149	7458.3963

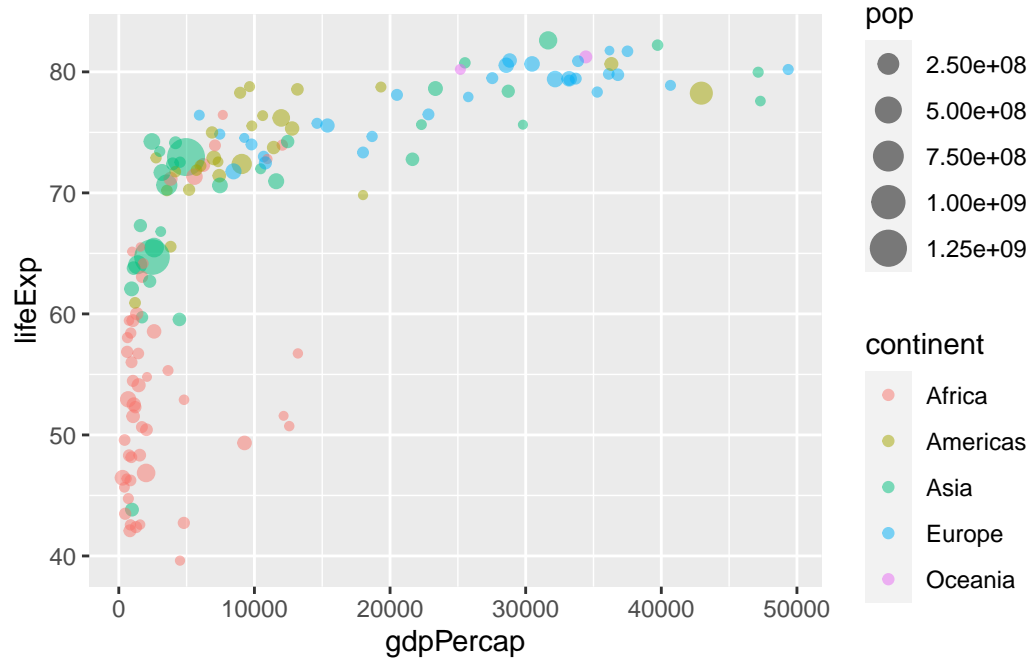
129	Togo	Africa	2007	58.420	5701579	882.9699
130	Trinidad and Tobago	Americas	2007	69.819	1056608	18008.5092
131	Tunisia	Africa	2007	73.923	10276158	7092.9230
132	Turkey	Europe	2007	71.777	71158647	8458.2764
133	Uganda	Africa	2007	51.542	29170398	1056.3801
134	United Kingdom	Europe	2007	79.425	60776238	33203.2613
135	United States	Americas	2007	78.242	301139947	42951.6531
136	Uruguay	Americas	2007	76.384	3447496	10611.4630
137	Venezuela	Americas	2007	73.747	26084662	11415.8057
138	Vietnam	Asia	2007	74.249	85262356	2441.5764
139	West Bank and Gaza	Asia	2007	73.422	4018332	3025.3498
140	Yemen, Rep.	Asia	2007	62.698	22211743	2280.7699
141	Zambia	Africa	2007	42.384	11746035	1271.2116
142	Zimbabwe	Africa	2007	43.487	12311143	469.7093

```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point(alpha=.5)
```

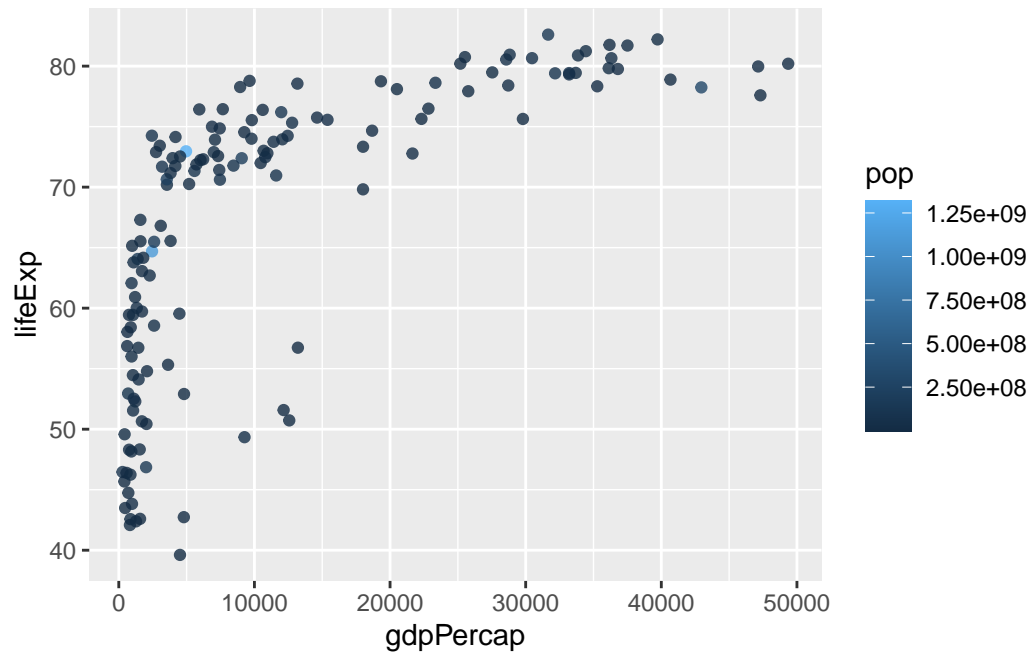


```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
```

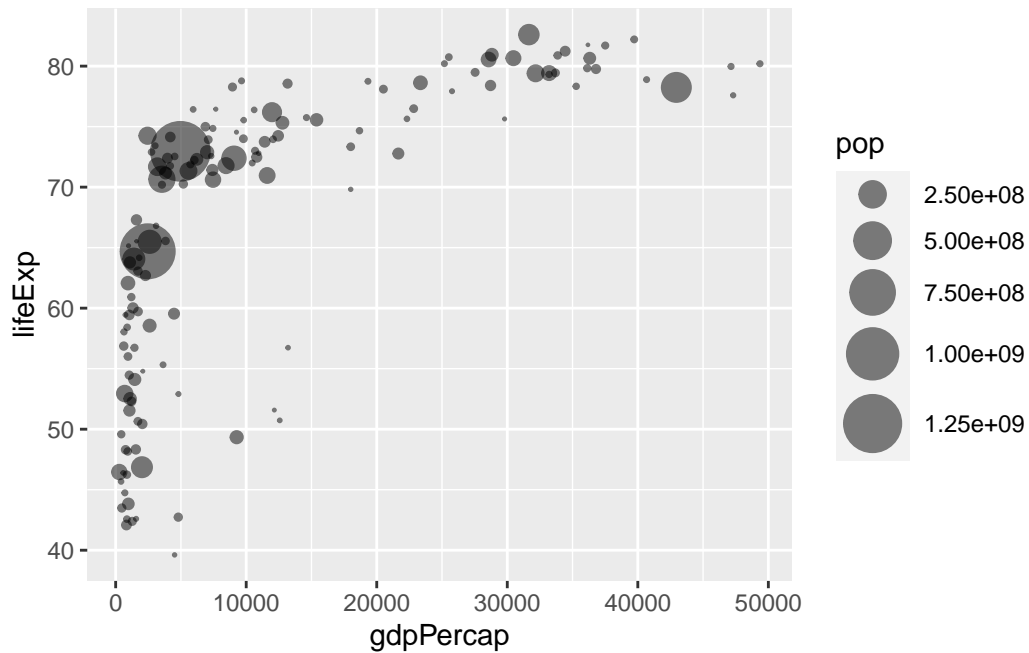
```
geom_point(alpha=0.5)
```



```
ggplot(gapminder_2007) +  
  aes(x=gdpPercap, y=lifeExp, color=pop) +  
  geom_point(alpha=0.8)
```



```
ggplot(gapminder_2007) +  
  aes(x = gdpPerCap, y = lifeExp, size = pop) +  
  geom_point(alpha=0.5)+  
  scale_size_area(max_size = 10)
```



```
gapminder_1957 <- gapminder %>% filter(year==1957)
gapminder_1957
```

	country	continent	year	lifeExp	pop	gdpPercap
1	Afghanistan	Asia	1957	30.33200	9240934	820.8530
2	Albania	Europe	1957	59.28000	1476505	1942.2842
3	Algeria	Africa	1957	45.68500	10270856	3013.9760
4	Angola	Africa	1957	31.99900	4561361	3827.9405
5	Argentina	Americas	1957	64.39900	19610538	6856.8562
6	Australia	Oceania	1957	70.33000	9712569	10949.6496
7	Austria	Europe	1957	67.48000	6965860	8842.5980
8	Bahrain	Asia	1957	53.83200	138655	11635.7995
9	Bangladesh	Asia	1957	39.34800	51365468	661.6375
10	Belgium	Europe	1957	69.24000	8989111	9714.9606
11	Benin	Africa	1957	40.35800	1925173	959.6011
12	Bolivia	Americas	1957	41.89000	3211738	2127.6863
13	Bosnia and Herzegovina	Europe	1957	58.45000	3076000	1353.9892
14	Botswana	Africa	1957	49.61800	474639	918.2325
15	Brazil	Americas	1957	53.28500	65551171	2487.3660
16	Bulgaria	Europe	1957	66.61000	7651254	3008.6707
17	Burkina Faso	Africa	1957	34.90600	4713416	617.1835
18	Burundi	Africa	1957	40.53300	2667518	379.5646

19	Cambodia	Asia	1957	41.36600	5322536	434.0383
20	Cameroon	Africa	1957	40.42800	5359923	1313.0481
21	Canada	Americas	1957	69.96000	17010154	12489.9501
22	Central African Republic	Africa	1957	37.46400	1392284	1190.8443
23	Chad	Africa	1957	39.88100	2894855	1308.4956
24	Chile	Americas	1957	56.07400	7048426	4315.6227
25	China	Asia	1957	50.54896	637408000	575.9870
26	Colombia	Americas	1957	55.11800	14485993	2323.8056
27	Comoros	Africa	1957	42.46000	170928	1211.1485
28	Congo, Dem. Rep.	Africa	1957	40.65200	15577932	905.8602
29	Congo, Rep.	Africa	1957	45.05300	940458	2315.0566
30	Costa Rica	Americas	1957	60.02600	1112300	2990.0108
31	Cote d'Ivoire	Africa	1957	42.46900	3300000	1500.8959
32	Croatia	Europe	1957	64.77000	3991242	4338.2316
33	Cuba	Americas	1957	62.32500	6640752	6092.1744
34	Czech Republic	Europe	1957	69.03000	9513758	8256.3439
35	Denmark	Europe	1957	71.81000	4487831	11099.6593
36	Djibouti	Africa	1957	37.32800	71851	2864.9691
37	Dominican Republic	Americas	1957	49.82800	2923186	1544.4030
38	Ecuador	Americas	1957	51.35600	4058385	3780.5467
39	Egypt	Africa	1957	44.44400	25009741	1458.9153
40	El Salvador	Americas	1957	48.57000	2355805	3421.5232
41	Equatorial Guinea	Africa	1957	35.98300	232922	426.0964
42	Eritrea	Africa	1957	38.04700	1542611	344.1619
43	Ethiopia	Africa	1957	36.66700	22815614	378.9042
44	Finland	Europe	1957	67.49000	4324000	7545.4154
45	France	Europe	1957	68.93000	44310863	8662.8349
46	Gabon	Africa	1957	38.99900	434904	4976.1981
47	Gambia	Africa	1957	32.06500	323150	520.9267
48	Germany	Europe	1957	69.10000	71019069	10187.8267
49	Ghana	Africa	1957	44.77900	6391288	1043.5615
50	Greece	Europe	1957	67.86000	8096218	4916.2999
51	Guatemala	Americas	1957	44.14200	3640876	2617.1560
52	Guinea	Africa	1957	34.55800	2876726	576.2670
53	Guinea-Bissau	Africa	1957	33.48900	601095	431.7905
54	Haiti	Americas	1957	40.69600	3507701	1726.8879
55	Honduras	Americas	1957	44.66500	1770390	2220.4877
56	Hong Kong, China	Asia	1957	64.75000	2736300	3629.0765
57	Hungary	Europe	1957	66.41000	9839000	6040.1800
58	Iceland	Europe	1957	73.47000	165110	9244.0014
59	India	Asia	1957	40.24900	409000000	590.0620
60	Indonesia	Asia	1957	39.91800	90124000	858.9003
61	Iran	Asia	1957	47.18100	19792000	3290.2576

62	Iraq	Asia	1957	48.43700	6248643	6229.3336
63	Ireland	Europe	1957	68.90000	2878220	5599.0779
64	Israel	Asia	1957	67.84000	1944401	5385.2785
65	Italy	Europe	1957	67.81000	49182000	6248.6562
66	Jamaica	Americas	1957	62.61000	1535090	4756.5258
67	Japan	Asia	1957	65.50000	91563009	4317.6944
68	Jordan	Asia	1957	45.66900	746559	1886.0806
69	Kenya	Africa	1957	44.68600	7454779	944.4383
70	Korea, Dem. Rep.	Asia	1957	54.08100	9411381	1571.1347
71	Korea, Rep.	Asia	1957	52.68100	22611552	1487.5935
72	Kuwait	Asia	1957	58.03300	212846	113523.1329
73	Lebanon	Asia	1957	59.48900	1647412	6089.7869
74	Lesotho	Africa	1957	45.04700	813338	335.9971
75	Liberia	Africa	1957	39.48600	975950	620.9700
76	Libya	Africa	1957	45.28900	1201578	3448.2844
77	Madagascar	Africa	1957	38.86500	5181679	1589.2027
78	Malawi	Africa	1957	37.20700	3221238	416.3698
79	Malaysia	Asia	1957	52.10200	7739235	1810.0670
80	Mali	Africa	1957	35.30700	4241884	490.3822
81	Mauritania	Africa	1957	42.33800	1076852	846.1203
82	Mauritius	Africa	1957	58.08900	609816	2034.0380
83	Mexico	Americas	1957	55.19000	35015548	4131.5466
84	Mongolia	Asia	1957	45.24800	882134	912.6626
85	Montenegro	Europe	1957	61.44800	442829	3682.2599
86	Morocco	Africa	1957	45.42300	11406350	1642.0023
87	Mozambique	Africa	1957	33.77900	7038035	495.5868
88	Myanmar	Asia	1957	41.90500	21731844	350.0000
89	Namibia	Africa	1957	45.22600	548080	2621.4481
90	Nepal	Asia	1957	37.68600	9682338	597.9364
91	Netherlands	Europe	1957	72.99000	11026383	11276.1934
92	New Zealand	Oceania	1957	70.26000	2229407	12247.3953
93	Nicaragua	Americas	1957	45.43200	1358828	3457.4159
94	Niger	Africa	1957	38.59800	3692184	835.5234
95	Nigeria	Africa	1957	37.80200	37173340	1100.5926
96	Norway	Europe	1957	73.44000	3491938	11653.9730
97	Oman	Asia	1957	40.08000	561977	2242.7466
98	Pakistan	Asia	1957	45.55700	46679944	747.0835
99	Panama	Americas	1957	59.20100	1063506	2961.8009
100	Paraguay	Americas	1957	63.19600	1770902	2046.1547
101	Peru	Americas	1957	46.26300	9146100	4245.2567
102	Philippines	Asia	1957	51.33400	26072194	1547.9448
103	Poland	Europe	1957	65.77000	28235346	4734.2530
104	Portugal	Europe	1957	61.51000	8817650	3774.5717

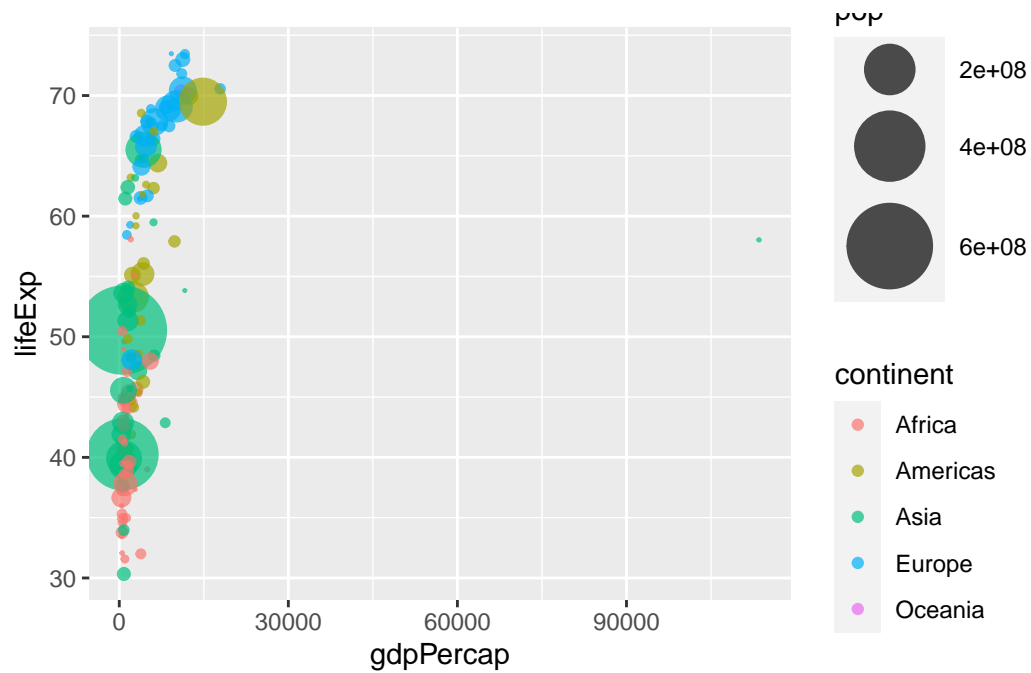
105	Puerto Rico	Americas	1957	68.54000	2260000	3907.1562
106	Reunion	Africa	1957	55.09000	308700	2769.4518
107	Romania	Europe	1957	64.10000	17829327	3943.3702
108	Rwanda	Africa	1957	41.50000	2822082	540.2894
109	Sao Tome and Principe	Africa	1957	48.94500	61325	860.7369
110	Saudi Arabia	Asia	1957	42.86800	4419650	8157.5912
111	Senegal	Africa	1957	39.32900	3054547	1567.6530
112	Serbia	Europe	1957	61.68500	7271135	4981.0909
113	Sierra Leone	Africa	1957	31.57000	2295678	1004.4844
114	Singapore	Asia	1957	63.17900	1445929	2843.1044
115	Slovak Republic	Europe	1957	67.45000	3844277	6093.2630
116	Slovenia	Europe	1957	67.85000	1533070	5862.2766
117	Somalia	Africa	1957	34.97700	2780415	1258.1474
118	South Africa	Africa	1957	47.98500	16151549	5487.1042
119	Spain	Europe	1957	66.66000	29841614	4564.8024
120	Sri Lanka	Asia	1957	61.45600	9128546	1072.5466
121	Sudan	Africa	1957	39.62400	9753392	1770.3371
122	Swaziland	Africa	1957	43.42400	326741	1244.7084
123	Sweden	Europe	1957	72.49000	7363802	9911.8782
124	Switzerland	Europe	1957	70.56000	5126000	17909.4897
125	Syria	Asia	1957	48.28400	4149908	2117.2349
126	Taiwan	Asia	1957	62.40000	10164215	1507.8613
127	Tanzania	Africa	1957	42.97400	9452826	698.5356
128	Thailand	Asia	1957	53.63000	25041917	793.5774
129	Togo	Africa	1957	41.20800	1357445	925.9083
130	Trinidad and Tobago	Americas	1957	61.80000	764900	4100.3934
131	Tunisia	Africa	1957	47.10000	3950849	1395.2325
132	Turkey	Europe	1957	48.07900	25670939	2218.7543
133	Uganda	Africa	1957	42.57100	6675501	774.3711
134	United Kingdom	Europe	1957	70.42000	51430000	11283.1779
135	United States	Americas	1957	69.49000	171984000	14847.1271
136	Uruguay	Americas	1957	67.04400	2424959	6150.7730
137	Venezuela	Americas	1957	57.90700	6702668	9802.4665
138	Vietnam	Asia	1957	42.88700	28998543	676.2854
139	West Bank and Gaza	Asia	1957	45.67100	1070439	1827.0677
140	Yemen, Rep.	Asia	1957	33.97000	5498090	804.8305
141	Zambia	Africa	1957	44.07700	3016000	1311.9568
142	Zimbabwe	Africa	1957	50.46900	3646340	518.7643

```

ggplot(gapminder_1957) +
  aes(x=gdpPercap, y=lifeExp, color=continent,
      size = pop) +

```

```
geom_point(alpha=0.7) +  
scale_size_area(max_size = 15)
```



```
gapminder_1957 <- gapminder %>% filter(year==1957 | year==2007)  
ggplot(gapminder_1957) +  
  aes(x=gdpPercap, y=lifeExp, color=continent,  
       size = pop) +  
  geom_point(alpha=0.7) +  
  scale_size_area(max_size = 10) +  
  facet_wrap(~year)
```

