Essential Skills: Statistics optional

Ali Abdulmadzhidov

5 October 2016

1 Examining Data

1. Load data and get total number of observations

```
> data(islands)
> length(islands)
[1] 48
```

2. Mean and median

```
> mean(islands)
[1] 1252.729
> median(islands)
[1] 41
```

3. Size of smallest and biggest island

```
> range(islands)[1]
[1] 12
> range(islands)[2]
[1] 16988
```

4. Standart deviation and the range of the islands size using range

```
> sd(islands)
[1] 3371.146
> range(islands)[2] - range(islands)[1]
[1] 16976
```

5. Quantiles

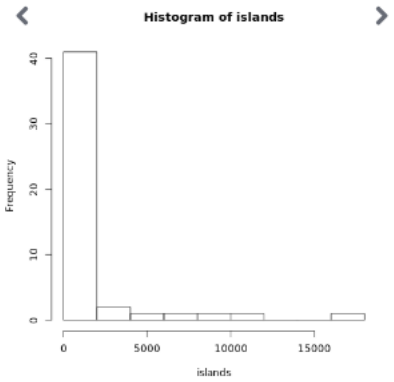
```
> quantile(islands)
      0%      25%      50%      75%     100%
   12.00    20.50    41.00   183.25 16988.00
> quantile(islands, c(.05,.95))
      5%     95%
   13.00 8481.75
```

6. Interquartile range

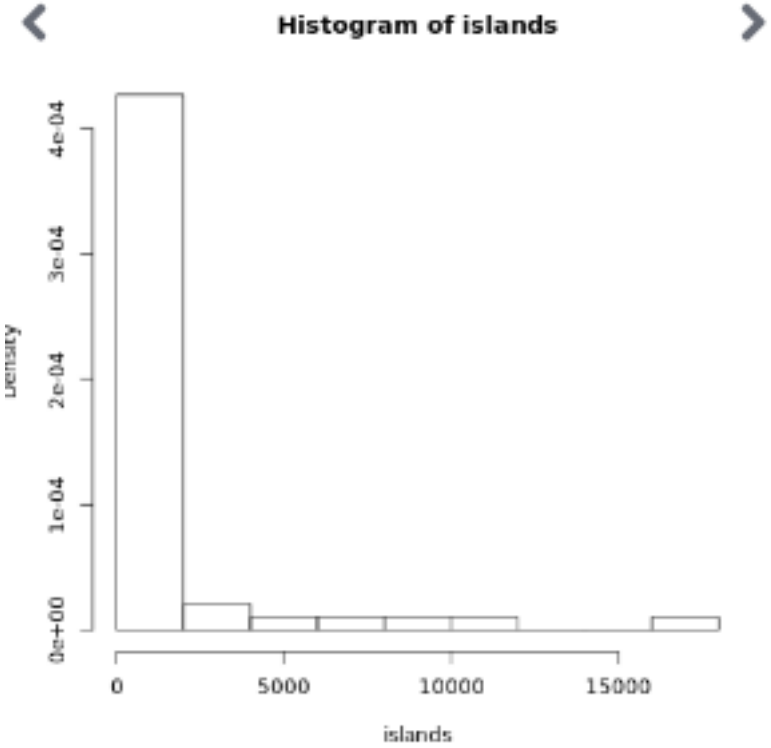
```
> IQR(islands)
[1] 162.75
```

7. Histogram showing frequency and proportion of each group

```
> hist(islands)
```

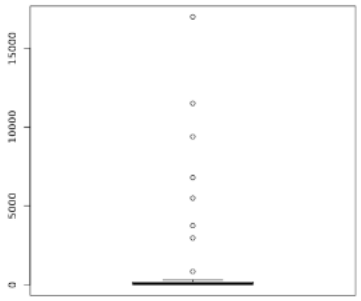



```
> hist(islands, prob=T)
```

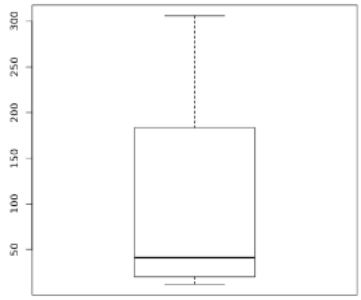


8. Create box-plots with outliers and without them

```
> boxplot(islands)
```



```
> boxplot(islands, outline = F)
```



9. Using the function boxplot find the outliers of islands.

```
> boxplot(islands, plot=F)$out
   Africa    Antarctica          Asia     Australia        Europe
    11506          5500         16988          2968          3745
Greenland North America South America
      840          9390          6795
```

10. Create box-plots with the following conditions

```
stem(islands)
```

```
> stem(islands)

  The decimal point is 3 digit(s) to the right of the |

   0 | 000000000000000000000000000000111111222338
   2 | 07
   4 | 5
   6 | 8
   8 | 4
  10 | 5
  12 |
  14 |
  16 | 0

>
```

2 Summary Statistics With Aggregate

1. Using R‘s built-in time series dataset, “AirPassengers“, compute the average annual standard deviation.

```
> aggregate(AirPassengers, nfrequency = 1, sd)
Time Series:
Start = 1949
End = 1960
Frequency = 1
 [1] 13.72015 19.07084 18.43827 22.96638 28.46689 34.92449 42.14046 47.86178
 [9] 57.89090 64.53047 69.83010 77.73713
```

2. Aggregate the "airquality" data by "airquality$Month", returning means on each of the numeric variables. Also, remove "NA" values.

```
> aggregate(airquality, list(airquality$Month), mean, na.rm=T)
  Group.1    Ozone  Solar.R      Wind     Temp Month  Day
1       5 23.61538 181.2963 11.622581 65.54839     5 16.0
2       6 29.44444 190.1667 10.266667 79.10000     6 15.5
3       7 59.11538 216.4839  8.941935 83.90323     7 16.0
4       8 59.96154 171.8571  8.793548 83.96774     8 16.0
5       9 31.44828 167.4333 10.180000 76.90000     9 15.5
```

3. Aggregate the "airquality" data by the variable "Day", remove "NA" values, and return means on each of the numeric variables.

```
> aggregate(airquality, list(airquality$Day), mean, na.rm=T)
   Group.1    Ozone  Solar.R      Wind     Temp    Month Day
1        1 77.75000 199.0000  6.780000 80.20000 7.000000   1
2        2 43.00000 174.8000  9.160000 80.80000 7.000000   2
3        3 33.25000 177.4000  9.620000 79.40000 7.000000   3
4        4 62.33333 197.2500  8.620000 81.80000 7.000000   4
5        5 48.66667 163.3333  8.460000 79.20000 7.000000   5
6        6 41.50000 223.3333 12.040000 79.80000 7.000000   6
7        7 54.20000 241.8000  7.660000 80.80000 7.000000   7
8        8 57.00000 217.6000  9.520000 81.20000 7.000000   8
9        9 61.40000 203.8000 11.700000 81.60000 7.000000   9
10      10 49.33333 234.6000  9.160000 82.00000 7.000000  10
11      11 25.50000 192.7500 10.560000 83.20000 7.000000  11
12      12 22.75000 244.2000 12.040000 79.20000 7.000000  12
13      13 23.40000 224.8000  9.980000 77.60000 7.000000  13
14      14 29.33333 215.6000 12.040000 78.00000 7.000000  14
15      15 12.66667 122.2000 12.400000 73.40000 7.000000  15
16      16 30.20000 218.6000 10.100000 75.40000 7.000000  16
17      17 36.60000 228.0000 12.620000 73.20000 7.000000  17
18      18 24.60000 108.4000 10.320000 71.60000 7.000000  18
19      19 35.20000 222.2000  9.860000 74.80000 7.000000  19
20      20 29.40000 158.4000  9.960000 76.60000 7.000000  20
21      21 12.75000 132.4000 10.200000 70.20000 7.000000  21
22      22 14.33333 137.4000 10.300000 74.60000 7.000000  22
23      23 20.00000 161.0000  9.740000 75.00000 7.000000  23
24      24 41.00000 179.4000  9.380000 74.20000 7.000000  24
25      25 96.66667 136.4000 10.520000 72.20000 7.000000  25
26      26 41.00000 176.4000  9.280000 74.80000 7.000000  26
27      27 52.00000 106.7500  9.840000 76.20000 7.000000  27
28      28 48.75000 143.6000 10.980000 81.40000 7.000000  28
29      29 57.75000 182.8000  9.500000 82.80000 7.000000  29
30      30 70.75000 214.8000  7.780000 81.80000 7.000000  30
31      31 60.33333 240.3333  7.633333 83.66667 6.666667  31
```

4. Aggregate "airquality$Solar.R" by "Month", returning means of "Solar.R". The header of column 1 should be "Month". Remove "not available" values.

```
> aggregate(airquality$Solar.R, list(Month=airquality$Month), mean, na.rm=T)
  Month        x
1     5 181.2963
2     6 190.1667
3     7 216.4839
4     8 171.8571
5     9 167.4333
```

5. Apply the standard deviation function to the data aggregation from Exercise

```
> aggregate(airquality$Solar.R, list(Month=airquality$Month), sd, na.rm=T)
  Month         x
1     5 115.07550
2     6  92.88298
3     7  80.56834
4     8  76.83494
5     9  79.11828
```

6. Use aggregate.formula for a oneto-one aggregation of “airquality” by the mean of “Ozone” to the grouping variable “Day“.

```
> aggregate(Ozone ~ Day, airquality, mean)
   Day    Ozone
1    1 77.75000
2    2 43.00000
3    3 33.25000
4    4 62.33333
5    5 48.66667
6    6 41.50000
7    7 54.20000
8    8 57.00000
9    9 61.40000
10  10 49.33333
11  11 25.50000
12  12 22.75000
13  13 23.40000
14  14 29.33333
15  15 12.66667
16  16 30.20000
17  17 36.60000
18  18 24.60000
19  19 35.20000
20  20 29.40000
21  21 12.75000
22  22 14.33333
23  23 20.00000
24  24 41.00000
25  25 96.66667
26  26 41.00000
27  27 52.00000
28  28 48.75000
29  29 57.75000
30  30 70.75000
31  31 60.33333
```

7. Use aggregate.formula for a many-to-one aggregation of “airquality” by the mean of “Solar.R” and “Ozone” by grouping variable, “Month“.

```
> aggregate(cbind(Solar.R, Ozone) ~ Month, airquality, mean)
  Month  Solar.R    Ozone
1     5 182.0417 24.12500
2     6 184.2222 29.44444
3     7 216.4231 59.11538
4     8 173.0870 60.00000
5     9 168.2069 31.44828
```

8. Use "." dot notation to find the means of the numeric variables in airquality", with the grouping variable of "Month"

```
> aggregate(. ~ Month, airquality, mean)
  Month    Ozone  Solar.R      Wind     Temp      Day
1     5 24.12500 182.0417 11.504167 66.45833 16.08333
2     6 29.44444 184.2222 12.177778 78.22222 14.33333
3     7 59.11538 216.4231  8.523077 83.88462 16.23077
4     8 60.00000 173.0870  8.860870 83.69565 17.17391
5     9 31.44828 168.2069 10.075862 76.89655 15.10345
```

9. Use dot notation to find the means of the "airquality" variables, with the grouping variables of "Day" and "Month". Display only the first 6 resulting observations.

```
> head(aggregate(. ~ Day + Month, airquality, mean))
  Day Month Ozone Solar.R Wind Temp
1   1     5    41     190  7.4   67
2   2     5    36     118  8.0   72
3   3     5    12     149 12.6   74
4   4     5    18     313 11.5   62
5   7     5    23     299  8.6   65
6   8     5    19      99 13.8   59
```

10. Use dot notation to find the means of "Temp", with the remaining "airquality" variables as grouping variables.

```
> aggregate(Temp ~ ., airquality, mean)
    Ozone Solar.R Wind Month Day Temp
1      41     190  7.4     5   1   67
2     135     269  4.1     7   1   84
3      39      83  6.9     8   1   81
4      96     167  6.9     9   1   91
5      36     118  8.0     5   2   72
6      49     248  9.2     7   2   85
7       9      24 13.8     8   2   81
8      78     197  5.1     9   2   92
9      12     149 12.6     5   3   74
10     32     236  9.2     7   3   81
11     16      77  7.4     8   3   82
12     73     183  2.8     9   3   93
13     18     313 11.5     5   4   62
14     91     189  4.6     9   4   93
15     64     175  4.6     7   5   83
16     47      95  7.4     9   5   87
17     40     314 10.9     7   6   83
18     32      92 15.5     9   6   84
19     23     299  8.6     5   7   65
20     29     127  9.7     6   7   82
21     77     276  5.1     7   7   88
22    122     255  4.0     8   7   89
23     20     252 10.9     9   7   80
24     19      99 13.8     5   8   59
25     97     267  6.3     7   8   92
26     89     229 10.3     8   8   90
27     23     220 10.3     9   8   78
28      8      19 20.1     5   9   61
29     71     291 13.8     6   9   90
30     97     272  5.7     7   9   92
```

31	110	207	8.0	8	9	90
32	21	230	10.9	9	9	75
33	39	323	11.5	6	10	87
34	85	175	7.4	7	10	89
35	24	259	9.7	9	10	73
36	44	236	14.9	9	11	81
37	16	256	9.7	5	12	69
38	10	264	14.3	7	12	73
39	44	192	11.5	8	12	86
40	21	259	15.5	9	12	76
41	11	290	9.2	5	13	66
42	23	148	8.0	6	13	82
43	27	175	14.9	7	13	81
44	28	273	11.5	8	13	82
45	28	238	6.3	9	13	77
46	14	274	10.9	5	14	68
47	65	157	9.7	8	14	80
48	9	24	10.9	9	14	71
49	18	65	13.2	5	15	58
50	7	48	14.3	7	15	80
51	13	112	11.5	9	15	71
52	14	334	11.5	5	16	64
53	21	191	14.9	6	16	77
54	48	260	6.9	7	16	81
55	22	71	10.3	8	16	77
56	46	237	6.9	9	16	78
57	34	307	12.0	5	17	66
58	37	284	20.7	6	17	72
59	35	274	10.3	7	17	82
60	59	51	6.3	8	17	79
61	18	224	13.8	9	17	67
62	6	78	18.4	5	18	57
63	20	37	9.2	6	18	65
64	61	285	6.3	7	18	84
65	23	115	7.4	8	18	76
66	13	27	10.3	9	18	76
67	30	322	11.5	5	19	68
68	12	120	11.5	6	19	73
69	79	187	5.1	7	19	87
70	31	244	10.9	8	19	78
71	24	238	10.3	9	19	68
72	11	44	9.7	5	20	62
73	13	137	10.3	6	20	76
74	63	220	11.5	7	20	85
75	44	190	10.3	8	20	78
76	16	201	8.0	9	20	82
77	1	8	9.7	5	21	59
78	16	7	6.9	7	21	74
79	21	259	15.5	8	21	77
80	13	238	12.6	9	21	64
81	11	320	16.6	5	22	73
82	9	36	14.3	8	22	72
83	23	14	9.2	9	22	71
84	4	25	9.7	5	23	61
85	36	139	10.3	9	23	81
86	32	92	12.0	5	24	61
87	80	294	8.6	7	24	86
88	45	212	9.7	8	24	79
89	7	49	10.3	9	24	69
90	108	223	8.0	7	25	85

91	168	238	3.4	8	25	81
92	14	20	16.6	9	25	63
93	20	81	8.6	7	26	82
94	73	215	8.0	8	26	86
95	30	193	6.9	9	26	70
96	52	82	12.0	7	27	86
97	23	13	12.0	5	28	67
98	82	213	7.4	7	28	88
99	76	203	9.7	8	28	97
100	14	191	14.3	9	28	75
101	45	252	14.9	5	29	81
102	50	275	7.4	7	29	86
103	118	225	2.3	8	29	94
104	18	131	8.0	9	29	76
105	115	223	5.7	5	30	79
106	64	253	7.4	7	30	83
107	84	237	6.3	8	30	96
108	20	223	11.5	9	30	68
109	37	279	7.4	5	31	76
110	59	254	9.2	7	31	81
111	85	188	6.3	8	31	94