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> #############################################################################
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> #Tosin Komolafe
> #Case Study 1
> #Statistics- 0617-B
> #Instructor: Professor Steven Stelk
> #############################################################################
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> #STEP 1:Download data for last 2 years for the NASDAQ Composite.
> #Downloaded from Yahoo Finance
> #NASDAQ Composite Historical Data from September 16, 2015 - September 15, 2017
> #############################################################################
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>
> nasdaq_composite_data = read.csv("IXIC.csv",header=TRUE, sep=",")
> nasdaq_composite = nasdaq_composite_data[,c(1,6)] # 1 & 6 is the Date & Adj. Close Column respe
ctively
> nasdaq_composite
        Date Adj.Close
1    2015-09-16   4889.24
2    2015-09-17   4893.95
3    2015-09-18   4827.23
4    2015-09-21   4828.95
5    2015-09-22   4756.72
6    2015-09-23   4752.74
7    2015-09-24   4734.48
8    2015-09-25   4686.50
9    2015-09-28   4543.97
10   2015-09-29   4517.32
11   2015-09-30   4620.16
12   2015-10-01   4627.08
13   2015-10-02   4707.78
14   2015-10-05   4781.26
15   2015-10-06   4748.36
16   2015-10-07   4791.15
17   2015-10-08   4810.79
18   2015-10-09   4830.47
19   2015-10-12   4838.64
20   2015-10-13   4796.61
21   2015-10-14   4782.85
22   2015-10-15   4870.10
23   2015-10-16   4886.69
24   2015-10-19   4905.47
25   2015-10-20   4880.97
26   2015-10-21   4840.12
27   2015-10-22   4920.05
28   2015-10-23   5031.86
29   2015-10-26   5034.70
30   2015-10-27   5030.15
31   2015-10-28   5095.69
32   2015-10-29   5074.27
33   2015-10-30   5053.75
34   2015-11-02   5127.15
35   2015-11-03   5145.13
36   2015-11-04   5142.48
37   2015-11-05   5127.74
38   2015-11-06   5147.12
39   2015-11-09   5095.30
40   2015-11-10   5083.24
41   2015-11-11   5067.02
42   2015-11-12   5005.08
43   2015-11-13   4927.88
44   2015-11-16   4984.62
45   2015-11-17   4986.02
46   2015-11-18   5075.20
47   2015-11-19   5073.64
48   2015-11-20   5104.92
```

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49   2015-11-23    5102.48
50   2015-11-24    5102.81
51   2015-11-25    5116.14
52   2015-11-27    5127.52
53   2015-11-30    5108.67
54   2015-12-01    5156.31
55   2015-12-02    5123.22
56   2015-12-03    5037.53
57   2015-12-04    5142.27
58   2015-12-07    5101.81
59   2015-12-08    5098.24
60   2015-12-09    5022.87
61   2015-12-10    5045.17
62   2015-12-11    4933.47
63   2015-12-14    4952.23
64   2015-12-15    4995.36
65   2015-12-16    5071.13
66   2015-12-17    5002.55
67   2015-12-18    4923.08
68   2015-12-21    4968.92
69   2015-12-22    5001.11
70   2015-12-23    5045.93
71   2015-12-24    5048.49
72   2015-12-28    5040.99
73   2015-12-29    5107.94
74   2015-12-30    5065.85
75   2015-12-31    5007.41
76   2016-01-04    4903.09
77   2016-01-05    4891.43
78   2016-01-06    4835.76
79   2016-01-07    4689.43
80   2016-01-08    4643.63
81   2016-01-11    4637.99
82   2016-01-12    4685.92
83   2016-01-13    4526.06
84   2016-01-14    4615.00
85   2016-01-15    4488.42
86   2016-01-19    4476.95
87   2016-01-20    4471.69
88   2016-01-21    4472.06
89   2016-01-22    4591.18
90   2016-01-25    4518.49
91   2016-01-26    4567.67
92   2016-01-27    4468.17
93   2016-01-28    4506.68
94   2016-01-29    4613.95
95   2016-02-01    4620.37
96   2016-02-02    4516.95
97   2016-02-03    4504.24
98   2016-02-04    4509.56
99   2016-02-05    4363.14
100  2016-02-08    4283.75
101  2016-02-09    4268.76
102  2016-02-10    4283.59
103  2016-02-11    4266.84
104  2016-02-12    4337.51
105  2016-02-16    4435.96
106  2016-02-17    4534.06
107  2016-02-18    4487.54
108  2016-02-19    4504.43
109  2016-02-22    4570.61
110  2016-02-23    4503.58
111  2016-02-24    4542.61
112  2016-02-25    4582.20
113  2016-02-26    4590.47
114  2016-02-29    4557.95
115  2016-03-01    4689.60
116  2016-03-02    4703.42
117  2016-03-03    4707.42
118  2016-03-04    4717.02
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119  2016-03-07     4708.25
120  2016-03-08     4648.82
121  2016-03-09     4674.38
122  2016-03-10     4662.16
123  2016-03-11     4748.47
124  2016-03-14     4750.28
125  2016-03-15     4728.67
126  2016-03-16     4763.97
127  2016-03-17     4774.99
128  2016-03-18     4795.65
129  2016-03-21     4808.87
130  2016-03-22     4821.66
131  2016-03-23     4768.86
132  2016-03-24     4773.50
133  2016-03-28     4766.79
134  2016-03-29     4846.62
135  2016-03-30     4869.29
136  2016-03-31     4869.85
137  2016-04-01     4914.54
138  2016-04-04     4891.80
139  2016-04-05     4843.93
140  2016-04-06     4920.72
141  2016-04-07     4848.37
142  2016-04-08     4850.69
143  2016-04-11     4833.40
144  2016-04-12     4872.09
145  2016-04-13     4947.42
146  2016-04-14     4945.89
147  2016-04-15     4938.22
148  2016-04-18     4960.02
149  2016-04-19     4940.33
150  2016-04-20     4948.13
151  2016-04-21     4945.89
152  2016-04-22     4906.23
153  2016-04-25     4895.79
154  2016-04-26     4888.28
155  2016-04-27     4863.14
156  2016-04-28     4805.29
157  2016-04-29     4775.36
158  2016-05-02     4817.59
159  2016-05-03     4763.22
160  2016-05-04     4725.64
161  2016-05-05     4717.09
162  2016-05-06     4736.16
163  2016-05-09     4750.21
164  2016-05-10     4809.88
165  2016-05-11     4760.69
166  2016-05-12     4737.33
167  2016-05-13     4717.68
168  2016-05-16     4775.46
169  2016-05-17     4715.73
170  2016-05-18     4739.12
171  2016-05-19     4712.53
172  2016-05-20     4769.56
173  2016-05-23     4765.78
174  2016-05-24     4861.06
175  2016-05-25     4894.89
176  2016-05-26     4901.77
177  2016-05-27     4933.50
178  2016-05-31     4948.05
179  2016-06-01     4952.25
180  2016-06-02     4971.36
181  2016-06-03     4942.52
182  2016-06-06     4968.71
183  2016-06-07     4961.75
184  2016-06-08     4974.64
185  2016-06-09     4958.62
186  2016-06-10     4894.55
187  2016-06-13     4848.44
188  2016-06-14     4843.55
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189 2016-06-15    4834.93
190 2016-06-16    4844.92
191 2016-06-17    4800.34
192 2016-06-20    4837.21
193 2016-06-21    4843.76
194 2016-06-22    4833.32
195 2016-06-23    4910.04
196 2016-06-24    4707.98
197 2016-06-27    4594.44
198 2016-06-28    4691.87
199 2016-06-29    4779.25
200 2016-06-30    4842.67
201 2016-07-01    4862.57
202 2016-07-05    4822.90
203 2016-07-06    4859.16
204 2016-07-07    4876.81
205 2016-07-08    4956.76
206 2016-07-11    4988.64
207 2016-07-12    5022.82
208 2016-07-13    5005.73
209 2016-07-14    5034.06
210 2016-07-15    5029.59
211 2016-07-18    5055.78
212 2016-07-19    5036.37
213 2016-07-20    5089.93
214 2016-07-21    5073.90
215 2016-07-22    5100.16
216 2016-07-25    5097.63
217 2016-07-26    5110.05
218 2016-07-27    5139.81
219 2016-07-28    5154.98
220 2016-07-29    5162.13
221 2016-08-01    5184.20
222 2016-08-02    5137.73
223 2016-08-03    5159.74
224 2016-08-04    5166.25
225 2016-08-05    5221.12
226 2016-08-08    5213.14
227 2016-08-09    5225.48
228 2016-08-10    5204.58
229 2016-08-11    5228.40
230 2016-08-12    5232.89
231 2016-08-15    5262.02
232 2016-08-16    5227.11
233 2016-08-17    5228.66
234 2016-08-18    5240.15
235 2016-08-19    5238.38
236 2016-08-22    5244.60
237 2016-08-23    5260.08
238 2016-08-24    5217.69
239 2016-08-25    5212.20
240 2016-08-26    5218.92
241 2016-08-29    5232.33
242 2016-08-30    5222.99
243 2016-08-31    5213.22
244 2016-09-01    5227.21
245 2016-09-02    5249.90
246 2016-09-06    5275.91
247 2016-09-07    5283.93
248 2016-09-08    5259.48
249 2016-09-09    5125.91
250 2016-09-12    5211.89
251 2016-09-13    5155.25
252 2016-09-14    5173.77
253 2016-09-15    5249.69
254 2016-09-16    5244.57
255 2016-09-19    5235.03
256 2016-09-20    5241.35
257 2016-09-21    5295.18
258 2016-09-22    5339.52
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259  2016-09-23    5305.75
260  2016-09-26    5257.49
261  2016-09-27    5305.71
262  2016-09-28    5318.55
263  2016-09-29    5269.15
264  2016-09-30    5312.00
265  2016-10-03    5300.87
266  2016-10-04    5289.66
267  2016-10-05    5316.02
268  2016-10-06    5306.85
269  2016-10-07    5292.40
270  2016-10-10    5328.67
271  2016-10-11    5246.79
272  2016-10-12    5239.02
273  2016-10-13    5213.33
274  2016-10-14    5214.16
275  2016-10-17    5199.82
276  2016-10-18    5243.84
277  2016-10-19    5246.41
278  2016-10-20    5241.83
279  2016-10-21    5257.40
280  2016-10-24    5309.83
281  2016-10-25    5283.40
282  2016-10-26    5250.27
283  2016-10-27    5215.97
284  2016-10-28    5190.10
285  2016-10-31    5189.14
286  2016-11-01    5153.58
287  2016-11-02    5105.57
288  2016-11-03    5058.41
289  2016-11-04    5046.37
290  2016-11-07    5166.17
291  2016-11-08    5193.49
292  2016-11-09    5251.07
293  2016-11-10    5208.80
294  2016-11-11    5237.11
295  2016-11-14    5218.40
296  2016-11-15    5275.62
297  2016-11-16    5294.58
298  2016-11-17    5333.97
299  2016-11-18    5321.51
300  2016-11-21    5368.86
301  2016-11-22    5386.35
302  2016-11-23    5380.68
303  2016-11-25    5398.92
304  2016-11-28    5368.81
305  2016-11-29    5379.92
306  2016-11-30    5323.68
307  2016-12-01    5251.11
308  2016-12-02    5255.65
309  2016-12-05    5308.89
310  2016-12-06    5333.00
311  2016-12-07    5393.76
312  2016-12-08    5417.36
313  2016-12-09    5444.50
314  2016-12-12    5412.54
315  2016-12-13    5463.83
316  2016-12-14    5436.67
317  2016-12-15    5456.85
318  2016-12-16    5437.16
319  2016-12-19    5457.44
320  2016-12-20    5483.94
321  2016-12-21    5471.43
322  2016-12-22    5447.42
323  2016-12-23    5462.69
324  2016-12-27    5487.44
325  2016-12-28    5438.56
326  2016-12-29    5432.09
327  2016-12-30    5383.12
328  2017-01-03    5429.08
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329  2017-01-04    5477.00
330  2017-01-05    5487.94
331  2017-01-06    5521.06
332  2017-01-09    5531.82
333  2017-01-10    5551.82
334  2017-01-11    5563.65
335  2017-01-12    5547.49
336  2017-01-13    5574.12
337  2017-01-17    5538.73
338  2017-01-18    5555.65
339  2017-01-19    5540.08
340  2017-01-20    5555.33
341  2017-01-23    5552.94
342  2017-01-24    5600.96
343  2017-01-25    5656.34
344  2017-01-26    5655.18
345  2017-01-27    5660.78
346  2017-01-30    5613.71
347  2017-01-31    5614.79
348  2017-02-01    5642.65
349  2017-02-02    5636.20
350  2017-02-03    5666.77
351  2017-02-06    5663.55
352  2017-02-07    5674.22
353  2017-02-08    5682.45
354  2017-02-09    5715.18
355  2017-02-10    5734.13
356  2017-02-13    5763.96
357  2017-02-14    5782.57
358  2017-02-15    5819.44
359  2017-02-16    5814.90
360  2017-02-17    5838.58
361  2017-02-21    5865.95
362  2017-02-22    5860.63
363  2017-02-23    5835.51
364  2017-02-24    5845.31
365  2017-02-27    5861.90
366  2017-02-28    5825.44
367  2017-03-01    5904.03
368  2017-03-02    5861.22
369  2017-03-03    5870.75
370  2017-03-06    5849.18
371  2017-03-07    5833.93
372  2017-03-08    5837.55
373  2017-03-09    5838.81
374  2017-03-10    5861.73
375  2017-03-13    5875.78
376  2017-03-14    5856.82
377  2017-03-15    5900.05
378  2017-03-16    5900.76
379  2017-03-17    5901.00
380  2017-03-20    5901.53
381  2017-03-21    5793.83
382  2017-03-22    5821.64
383  2017-03-23    5817.69
384  2017-03-24    5828.74
385  2017-03-27    5840.37
386  2017-03-28    5875.14
387  2017-03-29    5897.55
388  2017-03-30    5914.34
389  2017-03-31    5911.74
390  2017-04-03    5894.68
391  2017-04-04    5898.61
392  2017-04-05    5864.48
393  2017-04-06    5878.95
394  2017-04-07    5877.81
395  2017-04-10    5880.93
396  2017-04-11    5866.77
397  2017-04-12    5836.16
398  2017-04-13    5805.15
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399 2017-04-17    5856.79
400 2017-04-18    5849.47
401 2017-04-19    5863.03
402 2017-04-20    5916.78
403 2017-04-21    5910.52
404 2017-04-24    5983.82
405 2017-04-25    6025.49
406 2017-04-26    6025.23
407 2017-04-27    6048.94
408 2017-04-28    6047.61
409 2017-05-01    6091.60
410 2017-05-02    6095.37
411 2017-05-03    6072.55
412 2017-05-04    6075.34
413 2017-05-05    6100.76
414 2017-05-08    6102.66
415 2017-05-09    6120.59
416 2017-05-10    6129.14
417 2017-05-11    6115.96
418 2017-05-12    6121.23
419 2017-05-15    6149.67
420 2017-05-16    6169.87
421 2017-05-17    6011.24
422 2017-05-18    6055.13
423 2017-05-19    6083.70
424 2017-05-22    6133.62
425 2017-05-23    6138.71
426 2017-05-24    6163.02
427 2017-05-25    6205.26
428 2017-05-26    6210.19
429 2017-05-30    6203.19
430 2017-05-31    6198.52
431 2017-06-01    6246.83
432 2017-06-02    6305.80
433 2017-06-05    6295.68
434 2017-06-06    6275.06
435 2017-06-07    6297.38
436 2017-06-08    6321.76
437 2017-06-09    6207.92
438 2017-06-12    6175.46
439 2017-06-13    6220.37
440 2017-06-14    6194.89
441 2017-06-15    6165.50
442 2017-06-16    6151.76
443 2017-06-19    6239.01
444 2017-06-20    6188.03
445 2017-06-21    6233.95
446 2017-06-22    6236.69
447 2017-06-23    6265.25
448 2017-06-26    6247.15
449 2017-06-27    6146.62
450 2017-06-28    6234.41
451 2017-06-29    6144.35
452 2017-06-30    6140.42
453 2017-07-03    6110.06
454 2017-07-05    6150.86
455 2017-07-06    6089.46
456 2017-07-07    6153.08
457 2017-07-10    6176.39
458 2017-07-11    6193.30
459 2017-07-12    6261.17
460 2017-07-13    6274.44
461 2017-07-14    6312.47
462 2017-07-17    6314.43
463 2017-07-18    6344.31
464 2017-07-19    6385.04
465 2017-07-20    6390.00
466 2017-07-21    6387.75
467 2017-07-24    6410.81
468 2017-07-25    6412.17
```

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469 2017-07-26    6422.75
470 2017-07-27    6382.19
471 2017-07-28    6374.68
472 2017-07-31    6348.12
473 2017-08-01    6362.94
474 2017-08-02    6362.65
475 2017-08-03    6340.34
476 2017-08-04    6351.56
477 2017-08-07    6383.77
478 2017-08-08    6370.46
479 2017-08-09    6352.33
480 2017-08-10    6216.87
481 2017-08-11    6256.56
482 2017-08-14    6340.23
483 2017-08-15    6333.01
484 2017-08-16    6345.11
485 2017-08-17    6221.91
486 2017-08-18    6216.53
487 2017-08-21    6213.13
488 2017-08-22    6297.48
489 2017-08-23    6278.41
490 2017-08-24    6271.33
491 2017-08-25    6265.64
492 2017-08-28    6283.02
493 2017-08-29    6301.89
494 2017-08-30    6368.31
495 2017-08-31    6428.66
496 2017-09-01    6435.33
497 2017-09-05    6375.57
498 2017-09-06    6393.31
499 2017-09-07    6397.87
500 2017-09-08    6360.19
501 2017-09-11    6432.26
502 2017-09-12    6454.28
503 2017-09-13    6460.19
504 2017-09-14    6429.08
505 2017-09-15    6448.47
>
> ##############################################################################
##############################
> #STEP 2: Calculate Daily returns of NASDAQ composite for the last 1 year
> #NASDAQ one year will be from September 16, 2016 - September 15, 2017
> ##############################################################################
##############################
>
> last_one_year_nasdaq = nasdaq_composite[c(which(nasdaq_composite$Date=='2016-09-16'): which(nas
daq_composite$Date=='2017-09-15')),]
> count = length(last_one_year_nasdaq$Adj.Close)
> #daily_returns = numeric(count)
> for (i in 1:count-1){
+ last_one_year_nasdaq$Returns[i] = (last_one_year_nasdaq$Adj.Close[i+1]/last_one_year_nasdaq$Adj
.Close[i]-1)
+ }
> last_one_year_nasdaq
          Date Adj.Close        Returns
254 2016-09-16    5244.57 -1.819032e-03
255 2016-09-19    5235.03  1.207312e-03
256 2016-09-20    5241.35  1.027027e-02
257 2016-09-21    5295.18  8.373623e-03
258 2016-09-22    5339.52 -6.324542e-03
259 2016-09-23    5305.75 -9.095748e-03
260 2016-09-26    5257.49  9.171625e-03
261 2016-09-27    5305.71  2.420005e-03
262 2016-09-28    5318.55 -9.288228e-03
263 2016-09-29    5269.15  8.132260e-03
264 2016-09-30    5312.00 -2.095234e-03
265 2016-10-03    5300.87 -2.114740e-03
266 2016-10-04    5289.66  4.983281e-03
267 2016-10-05    5316.02 -1.724960e-03
268 2016-10-06    5306.85 -2.722933e-03
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269 2016-10-07    5292.40  6.853227e-03
270 2016-10-10    5328.67 -1.536591e-02
271 2016-10-11    5246.79 -1.480909e-03
272 2016-10-12    5239.02 -4.903578e-03
273 2016-10-13    5213.33  1.592222e-04
274 2016-10-14    5214.16 -2.750267e-03
275 2016-10-17    5199.82  8.465682e-03
276 2016-10-18    5243.84  4.901584e-04
277 2016-10-19    5246.41 -8.729927e-04
278 2016-10-20    5241.83  2.970303e-03
279 2016-10-21    5257.40  9.972644e-03
280 2016-10-24    5309.83 -4.977594e-03
281 2016-10-25    5283.40 -6.270561e-03
282 2016-10-26    5250.27 -6.532960e-03
283 2016-10-27    5215.97 -4.959790e-03
284 2016-10-28    5190.10 -1.849600e-04
285 2016-10-31    5189.14 -6.852784e-03
286 2016-11-01    5153.58 -9.315903e-03
287 2016-11-02    5105.57 -9.236906e-03
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338 2017-01-18    5555.65 -2.802521e-03
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479 2017-08-09   6352.33 -2.132445e-02
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485 2017-08-17   6221.91 -8.647459e-04
486 2017-08-18   6216.53 -5.469132e-04
487 2017-08-21   6213.13  1.357610e-02
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495 2017-08-31   6428.66  1.037529e-03
496 2017-09-01   6435.33 -9.286276e-03
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503 2017-09-13   6460.19 -4.815627e-03
504 2017-09-14   6429.08  3.016005e-03
505 2017-09-15   6448.47 -1.819032e-03
>
> ##############################################################################################
##############################
> #STEP 3: Graphically represent the stock prices as a line plot
> ##############################################################################################
##############################
> plot(nasdaq_composite, xlab="Date", ylab="Adj Close($)", main="NASDAQ Composite Price During Se
ptember 16, 2015 to September 15, 2017")
> lines(nasdaq_composite,col="blue")
>
> ##############################################################################################
##############################
> #STEP 4: Bucket the daily return values into bins and plot a histogram
> ##############################################################################################
##############################
> returns = last_one_year_nasdaq$Returns
> min=min(returns)
> max=max(returns)
> mean=mean(returns)
> median=median(returns)
> sd=sd(returns)
> skewness=(3*(mean-median))/sd
> par(oma=c(0,0,0,2))
> hist(returns, right=FALSE, breaks=seq(min,max,length=15),xlab="Daily Returns", ylab="Frequency"
,main="Daily Returns Distribution of NASDAQ Composite during September 16, 2016 - September 15, 2
017",col=c("blue"))
> points(seq(min, max, length.out=500),dnorm(seq(min,max,length.out=500),mean, sd), type="l", col
="red")
>
> ##############################################################################################
##############################
> #STEP 5: Calculate mean, median and standard deviation of Daily return values and plot them on
the same graph mentioned in step IV
> ##############################################################################################
##############################
>
> text(0.02, 50, paste("Mean=", format(round(mean,8))))
> text(0.02, 45, paste("Median=", format(round(median,8),nsmall=8)))
> text(0.018, 40, paste("Standard Deviation=", format(round(sd,8),nsmall=8)))
> text(0.019, 35, paste("Skewness=", format(round(skewness,8),nsmall=8)))
>
> ##############################################################################################
##############################
```

```
> # Based on your findings, evaluate the following:
> #############################################################################
##############################
> # Question 1: How is the daily returns of NASDAQ distributed? Does it follow a normal distribut
ion?
> #
> # Answer: The daily returns of NASDAQ follows an approximately symmertic normal distribution wi
th a bell-curve shape.
> # The skewness is around -0.013 which is closer to 0, mean is around 0.083% and standard deviat
ion is around 0.65%.
> #############################################################################
##############################
> # Question 2: Are any obvious trends visible in movement of NASDAQ prices for the period under
study?
> #
> # Answer: There is an uptrends. From early 2016 to the current date Sep 15, 2017
> #          The trend begined with a big up-surge from the bottom of the valley and even though s
ometimes it goes down, it has still
> #          remained an an upward momentum.
> #############################################################################
##############################
> # Question 3: Analyze the measures of central tendency calculated and offer opinion on the over
all risks and possible rewards
> #          associated with investing in the NASDAQ index for the period under study.
> #
> # Answer: During the period of study, we can earn so much return of investment in the uptrend p
eriod that began since early 2016
> #          Imagine, if we invest in 2016 with about $4,200, by current date, our return of inves
tment will be above 40%
> #      However, there are some risk involved in this portfolio that can cause significant risk an
d also losses. But in this NASDAQ
> #          composite, since it's a highly profitable portfolio, we can cut our loss when we reac
h a price surge less than 20-25%
> #          between our purchase price and current price.
> #############################################################################
##############################
>
```