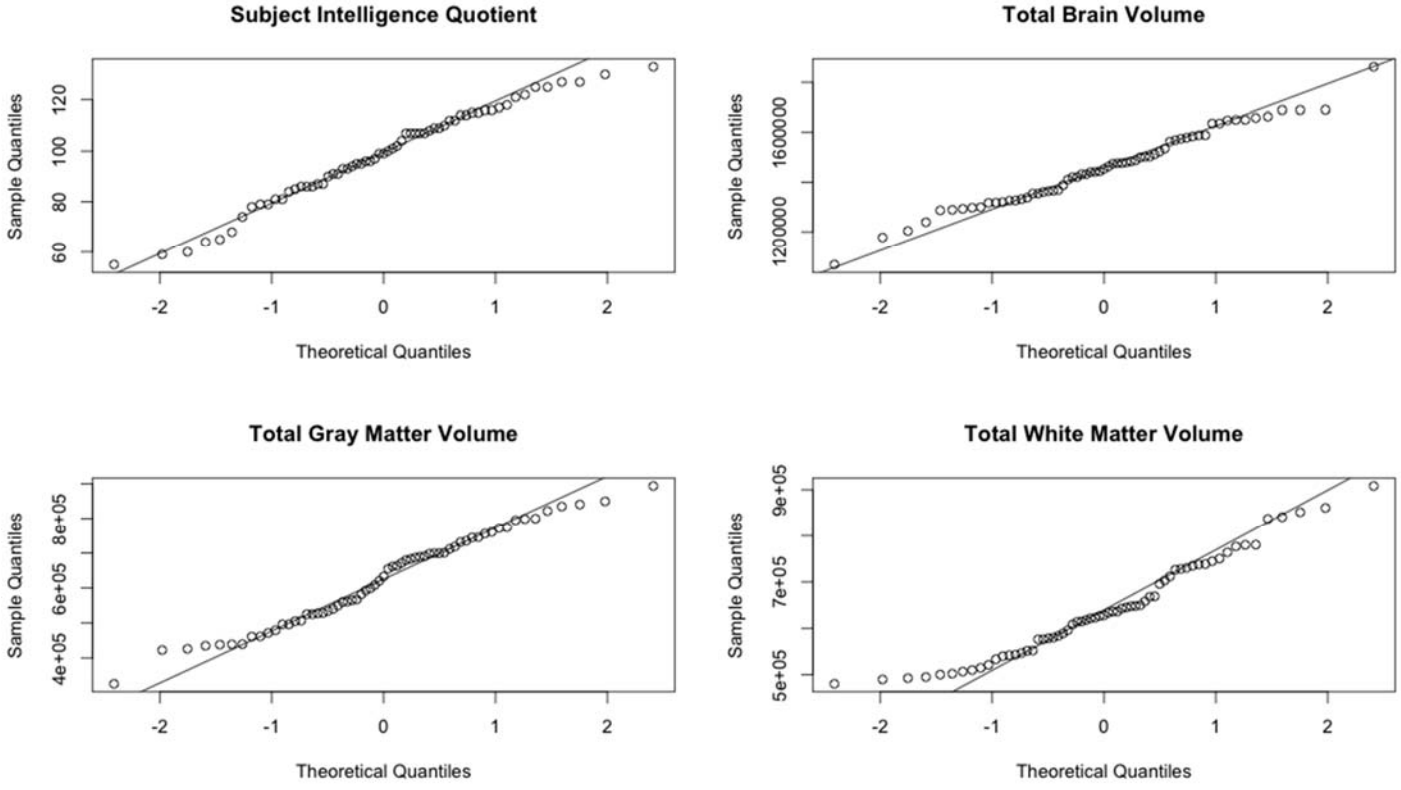
Scientific Methods for Health Sciences: Fundamentals (HS550): Fall 2014
http://www.socr.umich.edu/people/dinov/2014/Fall/HS550/
Homework 2[1] Solutions

Problem 1

For the data:
FS_IQ: Subject Intelligence Quotient. Mean = 98.57, Median = 99.00, Q1 = 86, Q3 = 113.00; standard deviation = 18.77345, variance = 352.4424.
TBV: Total Brain Volume. Mean = 1457412, Median = 1453510, Q1 = 1345940, Q3 = 1572110; standard deviation = 149031.2, variance = 22210301914.
GMV: Total Gray Matter Volume. Mean = 625505, Median = 633171, Q1 = 525699, Q3 = 725130; standard deviation = 132095.3, variance = 17449170245.
WMV: Total White Matter Volume. Mean = 640832, Median = 627691, Q1 = 551516, Q3 = 726837; standard deviation = 105770.7, variance = 11187445353.



By fitting a normal distribution to the four variables listed above, we can see that the Subject Intelligence Quotient follows a normal distribution pretty well except for a slight heavy tails on the ends with several outliers on the right end. Total Brian Volume has a heavier tail on the right end while the dataset as a whole follow the normal distribution decently. The Total Gray Matter Volume has heavy tails on both ends compared to the other three variables and Total White Matter Volume didn't follow a normal distribution as tightly as other three variables given there is several discordance in the middle as well as heavy tails on both ends.

[1] http://www.socr.umich.edu/people/dinov/2014/Fall/HS550/HWs.html
http://www.socr.umich.edu/people/dinov/2014/Fall/HS550/

RCODE:

```
data <- read.csv('~/HW2Prob1.csv')
attach(data)
dim(data)
summary(data)
sd(FS_IQ)
var(FS_IQ)
sd(TBV)
var(TBV)
sd(GMV)
var(GMV)
sd(WMV)
var(WMV)
par(mfrow=c(2,2))
qqnorm(FS_IQ,main='Subject Intelligence Quotient')
qqline(FS_IQ)
qqnorm(TBV,main='Total Brain Volume')
qqline(TBV)
qqnorm(GMV,main='Total Gray Matter Volume')
qqline(GMV)
qqnorm(WMV,main='Total White Matter Volume')
qqline(WMV)
```

Problem 2

In R simulate a timeseries of a clinical data with 1000 observations $S_t = S_0 e^{vt+\sigma\sqrt{t}z}, z \sim N(0,1)$ with two parameter sets for $(S_0, \sigma^2, v) = (1, 0.01, 3)$ and $(-10, 4, 6)$, the plot of the two time series are plotted as below. It is obvious that they are two completely different timeseries of data. They all became stationary after some point in the time series. For the first timeseries, it became stationary when t is around 237 and the second one reaches a stationary status when t is around 123. Both series have an increasing pattern but the shape of the two series are totally different: the slope first series increases slowly at first then with it began to increase sharply and achieves a stationary at infinity when t is around 237 while the second series increases sharply from the beginning and achieves stationary when t is round 123, so it's a lot faster in approaching a stationary status, which should be caused by the fact that the second timeseries is generated using a bigger v as well as a much σ.

Below we demonstrate how to solve the problem using a simple spreadsheet software or using R.

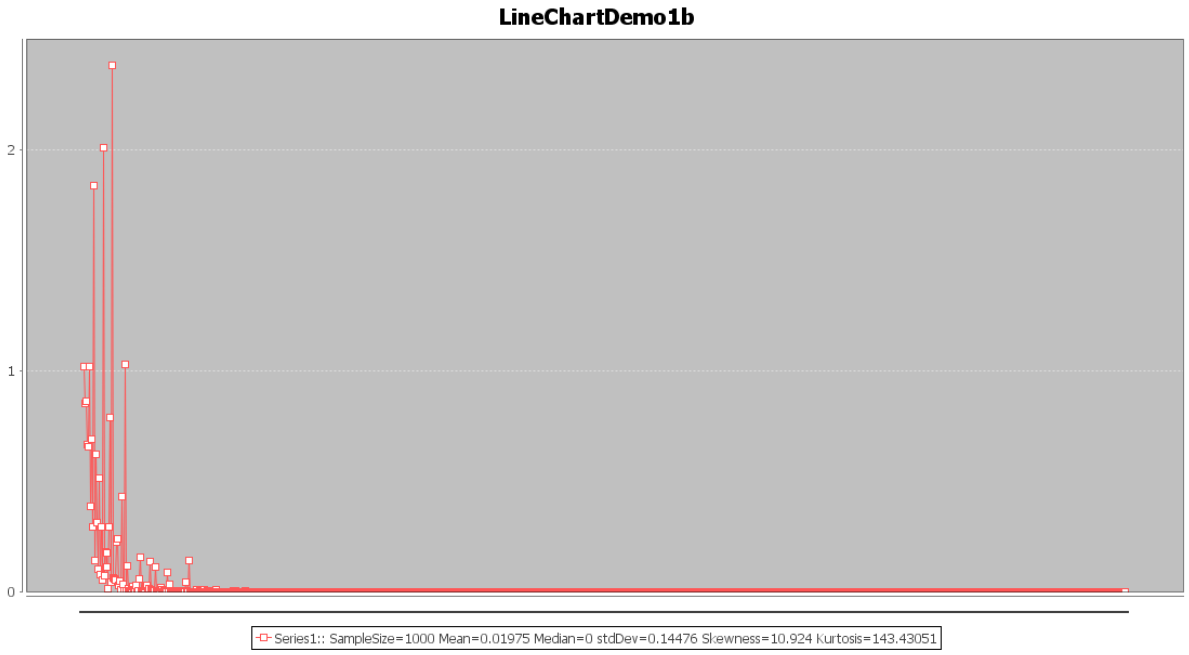
I. Spreadsheet data generation

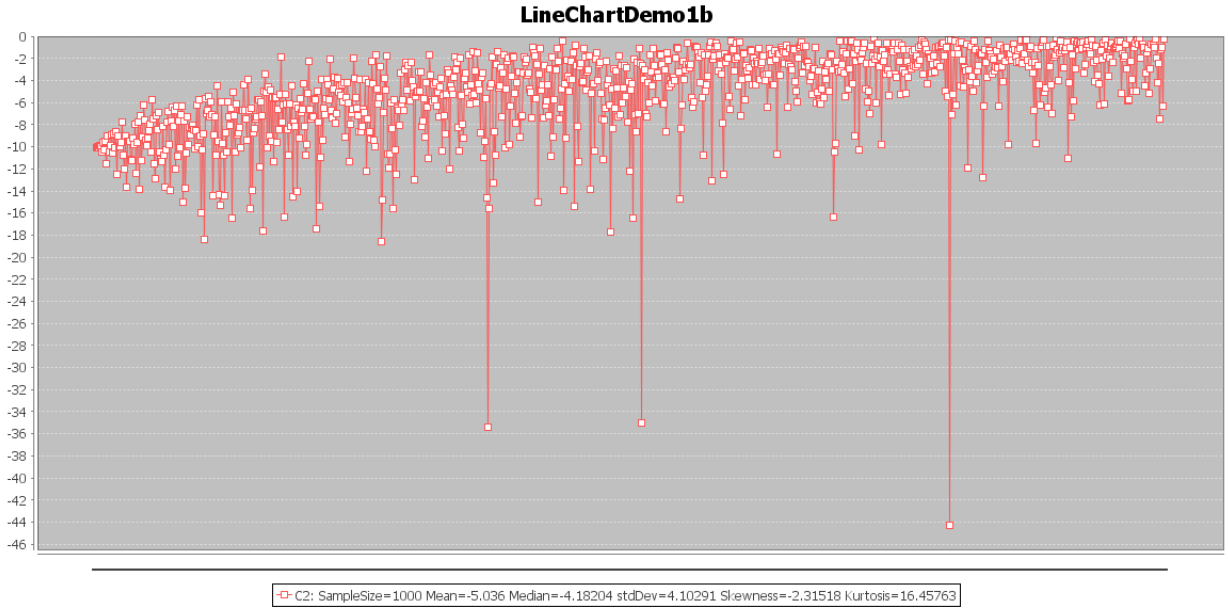
Open any spreadsheet software (e.g, Excel) and enter the first rows in these 3 columns as show below. Note that columns 1, 2, 3 and 4 contain the time variable ($0 \le t \le 999$), the randomly sampled Z values, and two explicit instances of the time-series (generically expressed as: $s_o * exp(v * t + \sqrt{sigma^2} * \sqrt{t} * z)$), were we have chosen the triples of parameters (s_o, v, sigma) differently in the two series. Everyone's solutions will be different, as the Z samples will be distinct and the triples of parameters will vary. Here are the explicit functions for the columns 3 (C) and 4 (D):

```
= 1*EXP(-0.1*A2+SQRT(0.1)*SQRT(A2)*B2)
=-10*EXP(-0.002*A2+SQRT(0.001)*SQRT(A2)*B2)
```

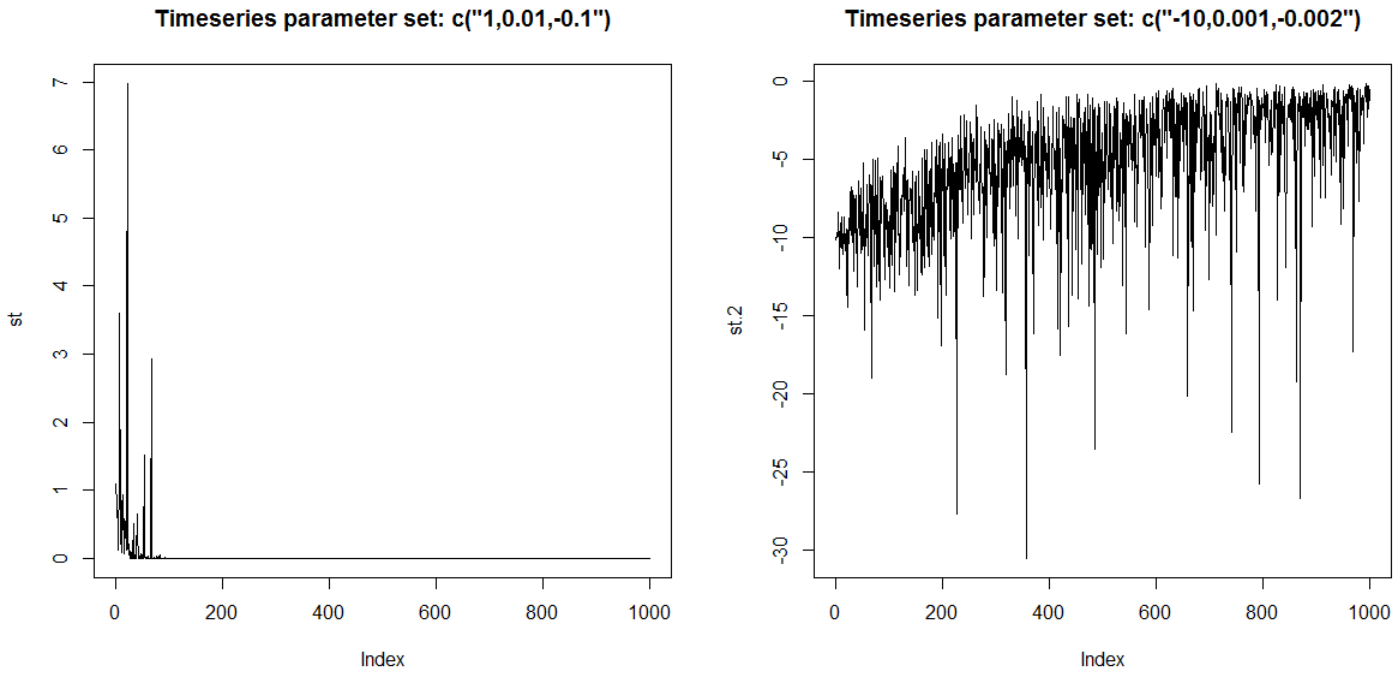
Time	Z_scores	Series1: 1*exp(-0.1*t+sqrt(0.1)*sqrt(t)*z)	Series2: -10*exp(-0.002*t+sqrt(0.001)*sqrt(t)*z)
1	0.964149356	1.227391023	-10.28898775
2	-0.743054415	0.587250363	-9.634541264
3	0.294293276	0.870394315	-10.10170478
4	0.125028527	0.725477648	-9.999075026
5	-0.533244979	0.416003693	-9.534139408
6	0.114662343	0.599785654	-9.968865637
7	0.663462724	0.86510252	-10.42382829
8	-0.598492884	0.263077054	-9.328313729
9	-0.28341978	0.310716111	-9.561049791
10	-1.457651263	0.085635851	-8.472452064
11	-0.683980244	0.162453328	-9.10522696
12	1.557027241	1.658042824	-11.57848786
13	-0.10032077	0.243075478	-9.632538221
14	1.535400471	1.516963042	-11.66107214
15	-0.683107755	0.096652547	-8.925584548
16	1.290650667	1.033094129	-11.40259457
17	-0.846743198	0.060566214	-8.655398992
18	-1.192371448	0.033382143	-8.220340868
19	0.352147736	0.243023327	-10.10595959
20	-1.017887459	0.032080393	-8.319765489
...	...	... See appendix at the end ...	...

Finally, you can copy and paste these series into SOCR Line Chart (http://wiki.socr.umich.edu/index.php/SOCR_EduMaterials_Activities_LineChart) to get the individual plots:





II. R data generation



RCODE:

```
z <- rnorm(1000,0,1)
t <- seq(0,999,by=1)

# set 1 parameters
s0 <- 1  # arbitrary value for s0
sig2 <- 0.1 # arbitrary value for sigma^2
v <- -0.1 # arbitrary value for the slope constant v
st <- s0*exp(v*t+sqrt(sig2)*sqrt(t)*z)
```

```
# set 2 parameters
s0.2 <- -10  # arbitrary value for s0
sig2.2 <- 0.001 # arbitrary value for sigma^2
v.2 <- -0.002 # arbitrary value for the slope constant v
st.2 <- s0.2*exp(v.2*t+sqrt(sig2.2)*sqrt(t)*z)
par(mfrow=c(1,2))
plot(st,main='Timeseries parameter set: c("1,0.01,-0.1")',type='l')
plot(st.2,main='Timeseries parameter set: c("-10,0.001,-0.002")',type='l')

min(which((st=='Inf')=='TRUE'))  # when the timeesries get stationary # 238
t[min(which((st=='Inf')=='TRUE'))]  # 237
min(which((st.2=='0')=='TRUE'))  # when the timeesries get stationary #124
t[min(which((st.2=='0')=='TRUE'))] # 123
```

Problem 3

		Disease Status		Test Performance
		Disease	No Disease	
Screening Test	Positive	TP=123	FP=13	PPV=TP/(TP + FP)
	Negative	FN=23	TN=856	NPV=TN/(FN + TN)
Test Performance		Sensitivity= TP/(TP + FN)	Specificity= TN/(FP + TN)	

- PPV (positive predictive values) $= TP/(TP + FP) = 123/(123 + 13) = 0.9044118$
- NPV (negative predictive values) $= TN/(TN + FN) = 856/(856 + 23) = 0.9738339$

Problem 4

The CLT provides the means to estimate $\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}}$, in general for any sample-size n. With a sample of 10 TBI patient, the sampling standard deviation $\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{10}}$, where σ_x is the standard deviation of the raw cognitive performance measure.

$\sigma_{\bar{x}}$ only depends on the process standard deviation, σ_x, which is affected by the shape of the original process.
For $\sigma_{\bar{x}} = \frac{\sigma_x}{2}$, the cohort study should have 4 patients, and $\sigma_{\bar{x}} = 0.1\sigma_x$, the cohort should have 100 patients.

From the SOCR Modeler of Beta(generalized) Distribution, we have the probability that a randomly chosen TBI patient will have a cognitive test exceeding 90 is 0. 011806, that is 1.11806%. (http://socr.ucla.edu/htmls/dist/BetaGeneral_Distribution.html)

Generating 1000 random scores following a Generalized Beta ($\alpha = 4, \beta = 3, A = 0, B = 100$) using SOCR Modeler: there are 26 scores greater than 90 out of 1000, so, the proportion of cognitive scores above 90 is 0.026, that is 2.6%. This value is a bigger compared to what we got in the theoretical case, which is not unexpected since a sample size of 1000 may not be sufficiently enough to mimic a theoretical case of

randomly chosen TBI patient, and the random essence of simulation could have contributed to this discrepancy as well.

Here is the list of random cognitive scores generated in SOCR Modeler for reference:

Time	Z_scores	Series1: 1*exp(-0.1*t+sqrt(0.1)*sqrt(t)*z)	Series2: -10*exp(-0.002*t+sqrt(0.001)*sqrt(t)*z)
1	0.370828067	1.017416052	-10.0977407
2	0.08653249	0.85103545	-9.998698591
3	0.271281576	0.859492688	-10.08898058
4	-0.012406854	0.665080772	-9.912537942
5	0.106029781	0.653753034	-9.975005665
6	0.795699267	1.016480329	-10.50887032
7	-0.304519062	0.384897226	-9.612912054
8	0.478112448	0.689103896	-10.27125041
9	-0.350213367	0.291638117	-9.500656826
10	1.608061121	1.836866483	-11.51201422
11	-0.823101881	0.140397649	-8.973335337
12	0.659769517	0.620481987	-10.49458303
13	0.117859195	0.311729379	-9.875165881
14	-0.757118771	0.100677291	-8.890662706
15	0.678217421	0.51203787	-10.5449748
16	-0.753458206	0.077843286	-8.804644187
17	0.359609993	0.291963661	-10.12970807
18	-0.863739181	0.051879699	-8.590889846
19	1.884666109	2.009393535	-12.48300836
20	-0.471114953	0.069511911	-8.988620401
21	0.257486554	0.177840796	-9.953243118
22	0.307894224	0.174938803	-10.01669486
23	0.064711646	0.110597264	-9.644608939
24	-1.341842407	0.011347324	-7.742369372
25	0.802745681	0.292074132	-10.79961332
26	1.465243631	0.788702856	-12.02332519
27	-0.319990856	0.039724044	-8.989032562
28	2.192351437	2.383346573	-13.64585285
29	0.055104862	0.060436636	-9.525468563
30	0.076706546	0.056861297	-9.543602707
31	0.060941559	0.050151778	-9.500220052
32	0.947008426	0.221808734	-11.1116167
33	1.022112058	0.236161062	-11.27131462
34	-0.078281009	0.028887594	-9.208719327
35	0.243605842	0.047631775	-9.758703689
36	-0.797247883	0.006019979	-7.99901127
37	1.486214398	0.431188675	-12.35998379
38	0.173541006	0.031376179	-9.587061824
39	-0.90882493	0.003363459	-7.729982123
40	2.014090796	1.028582449	-13.81014203
41	-1.21586562	0.001413141	-7.202232656

42	0.986496139	0.113235617	-11.2543716
43	-0.005840666	0.013405215	-9.164835632
44	-1.839853741	0.000258838	-6.225502217
45	-0.882851275	0.001707354	-7.578414857
46	0.167004794	0.014381471	-9.453675719
47	0.402074879	0.021746066	-9.931910434
48	0.084011038	0.009892869	-9.253399422
49	-0.253111828	0.004252336	-8.572474249
50	-0.577407032	0.001852681	-7.952393525
51	0.671146771	0.027755058	-10.50815238
52	-2.008073771	5.6622E-05	-5.7011837
53	-0.782429583	0.000824043	-7.511658467
54	1.069438994	0.054212252	-11.50866532
55	1.548621991	0.154407587	-12.88120333
56	-0.931287824	0.000408169	-7.172126332
57	-0.215288865	0.002001226	-8.475550281
58	-1.067780913	0.000231355	-6.885580181
59	0.6689848	0.01391147	-10.45500631
60	0.921832072	0.023707074	-11.11601558
61	0.993623341	0.026097092	-11.31344628
62	-0.304019996	0.000951945	-8.189761074
63	0.807489664	0.013936876	-10.7969468
64	1.742855644	0.136574473	-13.6740048
65	0.602024359	0.006977023	-10.23764682
66	-0.460920365	0.000416291	-7.784795272
67	-0.99046367	9.4799E-05	-6.768029145
68	0.440953792	0.003517048	-9.792059224
69	1.79354471	0.112057464	-13.95322614
70	-0.49282322	0.000247553	-7.630827745
71	-1.161561803	3.73537E-05	-6.366675064
72	-0.212337229	0.000422314	-8.179320148
73	-0.9673597	4.94939E-05	-6.654004771
74	1.208010781	0.016344638	-11.97953232
75	-1.149874669	2.37231E-05	-6.281940602
76	0.847208479	0.005172457	-10.84977511
77	-0.399007082	0.000149652	-7.674208194
78	0.602173713	0.002202372	-10.12252419
79	-0.667789807	5.67444E-05	-7.077281194
80	-1.069138884	1.63059E-05	-6.297715515
81	1.993354596	0.088317822	-14.9978035
82	-0.364589395	9.66876E-05	-7.645999567
83	1.695005649	0.03281938	-13.80335232
84	0.770234435	0.002096159	-10.56789087
85	-0.503532828	4.68744E-05	-7.284736787
86	0.528258806	0.00086668	-9.830609976
87	-0.065406643	0.000137358	-8.242411056
88	0.192487627	0.000266806	-8.878975252

89	-0.067573157	0.000111488	-8.20239416
90	-0.119940992	8.61153E-05	-8.057495654
91	0.029479019	0.000122051	-8.410473669
92	0.669495683	0.000769847	-10.19251052
93	0.093572046	0.000121616	-8.543072597
94	-0.952638835	4.45833E-06	-6.187378906
95	0.598410296	0.000473397	-9.944578551
96	-1.177326761	1.7642E-06	-5.73050545
97	0.283290576	0.000148089	-8.99631853
98	2.116003921	0.041758179	-15.94266898
99	0.706871938	0.000463882	-10.24712477
100	0.232380864	9.46668E-05	-8.811611801
101	2.556863422	0.138877792	-18.41506354
102	-1.136834312	9.84869E-07	-5.671815892
103	-0.480272531	7.20044E-06	-6.97580885
104	-0.596362839	4.4473E-06	-6.701047492
105	-1.233551032	5.05781E-07	-5.435050837
106	-0.337436489	8.30533E-06	-7.247986686
107	-0.924000714	1.09749E-06	-5.967550635
108	-0.409357503	5.31336E-06	-7.043156878
109	1.777936644	0.006538053	-14.46270848
110	0.309547486	4.66262E-05	-8.892874869
111	-0.271183488	6.12279E-06	-7.317259009
112	0.895456087	0.000273768	-10.78614045
113	-1.727807856	3.71572E-08	-4.462790826
114	0.530776943	6.71964E-05	-9.52381987
115	1.747011789	0.003789221	-14.36831758
116	1.921857221	0.006381257	-15.25864269
117	-0.860151034	4.37509E-07	-5.896554349
118	0.590103982	5.69734E-05	-9.672554746
119	0.909293994	0.000156373	-10.7861033
120	1.743369694	0.002577874	-14.38960499
121	0.290196792	1.52558E-05	-8.68441643
122	0.819595552	8.80791E-05	-10.43178622
123	-0.775417939	2.99996E-07	-5.957408127
124	-0.181282578	2.17526E-06	-7.321014491
125	0.100171561	5.31042E-06	-8.068770271
126	-0.484902439	6.0307E-07	-6.543432024
127	2.104958571	0.005524588	-16.42378236
128	-1.197954996	3.79903E-08	-5.0429523
129	-0.209435763	1.17738E-06	-7.166109867
130	0.839309405	4.66039E-05	-10.43538466
131	-0.621247894	2.15881E-07	-6.145567646
132	0.414295347	8.33714E-06	-8.927229205
133	0.352247243	6.05041E-06	-8.715009084
134	0.190770844	3.04605E-06	-8.20233351
135	0.749312958	2.15131E-05	-10.05329311

136	-0.346798657	3.45273E-07	-6.703917572
137	-0.328866412	3.32293E-07	-6.731917942
138	-1.499845244	3.86356E-09	-4.346701639
139	-0.314461188	2.84539E-07	-6.735186224
140	-0.025720178	7.55236E-07	-7.485452599
141	0.596389036	7.06356E-06	-9.435969956
142	-1.772870389	8.54344E-10	-3.859417792
143	-0.313961106	1.87919E-07	-6.671599463
144	1.931815596	0.00085085	-15.60603299
145	-0.350549912	1.32743E-07	-6.547607158
146	1.630440586	0.000231693	-13.92346528
147	0.423500431	2.09433E-06	-8.766675081
148	0.305205446	1.20884E-06	-8.364528546
149	0.011742705	3.53751E-07	-7.456736396
150	-0.035950925	2.66142E-07	-7.305747444
151	-0.661784672	2.11503E-08	-5.716884851
152	-0.626472385	2.17764E-08	-5.779638821
153	1.200442646	2.48056E-05	-11.77690969
154	-0.535233788	2.50997E-08	-5.956864116
155	-0.045837298	1.54904E-07	-7.20329767
156	2.221022899	0.001083388	-17.59859114
157	-0.984400746	3.0733E-09	-4.945775438
158	-1.923422665	6.57308E-11	-3.394103649
159	-0.906552685	3.34814E-09	-5.068774062
160	0.816758112	2.95218E-06	-10.06725762
161	-1.153349793	9.95482E-10	-4.562203517
162	0.540383529	8.11E-07	-8.989752054
163	-0.980034349	1.59448E-09	-4.85939183
164	0.680027269	1.18461E-06	-9.487500045
165	-0.641627321	5.03777E-09	-5.539780301
166	1.121570789	5.9604E-06	-11.33106166
167	-0.567754304	5.49095E-09	-5.67782763
168	-0.635013196	3.74524E-09	-5.508581422
169	0.71416072	8.61912E-07	-9.565604276
170	-0.182455583	1.95111E-08	-6.601895
171	0.407591513	2.02096E-07	-8.407573708
172	-0.719154325	1.71725E-09	-5.261052298
173	-3.255431036	4.03816E-14	-1.826761844
174	0.241769211	7.60785E-08	-7.810234795
175	-0.311328195	6.82701E-09	-6.186361834
176	2.012759051	0.000105584	-16.36238158
177	-0.694515556	1.10666E-09	-5.240374148
178	-0.300863838	5.22743E-09	-6.169701768
179	0.432337659	1.04838E-07	-8.393857622
180	1.016554341	1.13699E-06	-10.73889904
181	-0.302272151	3.80866E-09	-6.122595713
182	0.372648477	6.11322E-08	-8.146288027

183	-1.019611595	1.43923E-10	-4.483529426
184	1.721874376	1.64698E-05	-14.48606155
185	0.272253621	2.9793E-08	-7.765460839
186	0.400656576	4.70498E-08	-8.193811124
187	-0.219026844	2.93327E-09	-6.258059964
188	1.645832016	8.59919E-06	-14.01601844
189	-0.133483567	3.46585E-09	-6.465977976
190	0.681654829	1.09347E-07	-9.204675342
191	-0.437047856	7.50671E-10	-5.63828352
192	0.0184825	4.97414E-09	-6.866700531
193	-0.07184726	3.02717E-09	-6.586494886
194	-1.043242897	3.79403E-11	-4.284844499
195	0.425941951	2.22908E-08	-8.171691828
196	1.051070658	3.22645E-07	-10.76084313
197	0.847586332	1.19731E-07	-9.823560093
198	-0.580264898	1.90377E-10	-5.198569614
199	-2.478019654	3.60344E-14	-2.223661132
200	-0.022893875	1.86057E-09	-6.634920203
201	0.238378099	5.43026E-09	-7.444363747
202	0.170485964	3.63099E-09	-7.208126021
203	0.208614393	3.90864E-09	-7.319758937
204	-0.349574778	2.84895E-10	-5.678544178
205	-0.336728798	2.72167E-10	-5.698053615
206	2.132857629	1.81009E-05	-17.43761995
207	-0.633978532	5.72022E-11	-4.953737184
208	0.361432598	4.8146E-09	-7.778968293
209	1.855253872	4.0434E-06	-15.37499609
210	1.120391447	1.28708E-07	-10.97931397
211	-1.117176844	4.05236E-12	-3.925182534
212	0.791112788	2.37082E-08	-9.420053569
213	-0.019123897	5.14276E-10	-6.47377271
214	0.183746284	1.1892E-09	-7.096391178
215	-0.294941553	1.17147E-10	-5.673614093
216	-1.098975397	2.51795E-12	-3.895521202
217	-0.839374051	7.54544E-12	-4.382315801
218	-0.249068893	1.06496E-10	-5.756292797
219	-2.47680119	2.85189E-15	-2.024870293
220	0.094241468	4.34004E-10	-6.731434425
221	0.285109667	9.6424E-10	-7.349387409
222	-0.630592317	1.17033E-11	-4.765820394
223	-1.164091766	8.46915E-13	-3.694582228
224	0.435733649	1.4704E-09	-7.852342504
225	0.203526036	4.44269E-10	-7.022546972
226	-1.102476243	8.1051E-13	-3.767734416
227	-0.465409753	1.50835E-11	-5.087786502
228	-0.710501226	4.21405E-12	-4.514639811
229	-0.362518051	2.00099E-11	-5.318045805

230	-0.774045298	2.50636E-12	-4.355180295
231	-0.130853729	4.95066E-11	-5.916195395
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235	-0.833307644	1.09572E-12	-4.172954194
236	-0.08703044	3.69006E-11	-5.979314038
237	1.239900096	2.13154E-08	-11.38391353
238	0.508772808	5.51743E-10	-7.962883212
239	0.259619518	1.48449E-10	-7.039287184
240	0.12954007	7.12101E-11	-6.593250721
241	-2.371718345	2.99871E-16	-1.927583282
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243	-0.218332257	9.53292E-12	-5.523204078
244	0.130779804	4.82804E-11	-6.548169537
245	0.326737429	1.15387E-10	-7.201662262
246	0.699341089	6.64902E-10	-8.64902842
247	-0.904452582	2.09292E-13	-3.892611811
248	0.705011273	5.67902E-10	-8.651025556
249	0.582691671	2.81082E-10	-8.128266296
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258	-1.917126086	3.68241E-16	-2.254224052
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285	-0.977408428	2.27242E-15	-3.356140925
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288	0.332604966	1.85145E-12	-6.719942837
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478	-0.767693474	8.6227E-24	-2.261030491
479	0.202701447	6.40565E-21	-4.414410978
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488	0.299121164	5.17509E-21	-4.643842531
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492	-0.47487695	1.53502E-23	-2.679133773
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504	-0.806037563	4.23053E-25	-2.059277492
505	0.945644248	9.69652E-20	-7.131999244
506	1.220123787	6.22333E-19	-8.658175388
507	-0.598910419	1.34658E-24	-2.368216931
508	0.919507582	6.08247E-20	-6.972375739
509	-1.638131369	6.58806E-28	-1.122853019
510	-0.548855772	1.40836E-24	-2.436648846
511	3.183010279	4.88965E-13	-35.02060364

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513	0.118753669	1.23052E-22	-3.902593152
514	-0.226560343	9.37218E-24	-3.040905671
515	0.932790313	3.47548E-20	-6.972599239
516	1.003212607	5.24929E-20	-7.324494993
517	0.23665837	1.93191E-22	-4.21541852
518	0.741260885	6.61478E-21	-6.050173715
519	-1.033714476	1.6823E-26	-1.681825953
520	-0.147981956	8.97937E-24	-3.17679805
521	0.319659557	2.37307E-22	-4.442940426
522	-1.59558615	2.10506E-28	-1.111578416
523	-0.413848574	9.69613E-25	-2.604641442
524	0.698866773	2.75449E-21	-5.815226197
525	0.081191075	2.85121E-23	-3.711416524
526	-0.060742278	9.22119E-24	-3.341872354
527	0.095872452	2.59982E-23	-3.73662753
528	-1.051213728	5.64799E-27	-1.620500846
529	-1.024130684	6.17835E-27	-1.648243885
530	-0.44096915	3.87414E-25	-2.513194632
531	0.786055441	2.67047E-21	-6.131146125
532	0.791539719	2.52855E-21	-6.146734383
533	-0.166341974	2.11199E-24	-3.05000753
534	1.263867502	6.60252E-20	-8.655198367
535	-1.144482805	1.34801E-27	-1.485079179
536	-0.601671733	6.43822E-26	-2.203592666
537	0.387125585	8.13621E-23	-4.537026404
538	0.173288629	1.53803E-23	-3.871684463
539	0.312929371	3.88405E-23	-4.281602085
540	0.13160561	9.29189E-24	-3.740783459
541	0.113536225	7.36789E-24	-3.684349761
542	0.211562073	1.37299E-23	-3.952461166
543	-0.700606893	1.49862E-26	-2.014393478
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547	2.000380023	4.67034E-18	-14.70305246
548	1.231578906	1.44587E-20	-8.316872493
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556	-0.210637159	1.4829E-25	-2.810950373
557	-0.338734817	5.1508E-26	-2.54919866
558	0.704759913	1.12906E-22	-5.545775696

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562	-1.600834274	2.4028E-30	-0.978722741
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798	1.108481112	4.40303E-31	-5.456462278
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808	-0.262093754	7.68845E-37	-1.569868896
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811	-1.549620979	5.2246E-42	-0.489224193
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813	0.928387637	2.12478E-32	-4.543419165
814	0.417868834	1.9309E-34	-2.86221127
815	0.517985001	4.32376E-34	-3.127419511
816	-1.153796615	1.0842E-40	-0.689581248
817	2.001030031	2.36151E-28	-11.90879453
818	0.487670481	2.45604E-34	-3.027237917
819	0.831922984	5.02335E-33	-4.126641592
820	-0.858301445	1.02898E-39	-0.891687163
821	0.694466605	1.19459E-33	-3.632186064
822	1.049005886	2.70054E-32	-5.001100819
823	-1.652357588	5.59056E-43	-0.430665786
824	-0.492074533	1.88034E-38	-1.231098872
825	0.850037218	3.34061E-33	-4.156484886
826	0.537543014	1.77416E-34	-3.124044886
827	0.358970385	3.17383E-35	-2.651249693
828	-0.285059168	8.20178E-38	-1.472846486
829	-0.141753191	2.73189E-37	-1.674508368
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831	2.091933984	1.55626E-28	-12.77608937
832	1.318783354	1.23281E-31	-6.305993878
833	-0.473715189	8.82224E-39	-1.226581173
834	0.235434105	5.17134E-36	-2.338692458
835	0.737136517	4.58928E-34	-3.691999438
836	-1.658373778	1.28164E-43	-0.412418613
837	-0.443088101	7.74546E-39	-1.250088017
838	-0.196279898	6.69554E-38	-1.563467142
839	-0.001905707	3.59015E-37	-1.864214013
840	0.662761897	1.4365E-34	-3.421285664

841	0.136362163	1.04455E-36	-2.107784613
842	0.561541646	4.67961E-35	-3.107625223
843	0.412029372	1.0763E-35	-2.704426812
844	-0.40009427	5.6135E-39	-1.280205481
845	0.449351436	1.24744E-35	-2.78889755
846	1.347445923	4.3767E-32	-6.35945311
847	-0.881572848	4.91673E-41	-0.816482871
848	0.005363346	1.56055E-37	-1.843238415
849	0.42507887	6.75168E-36	-2.708128613
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856	0.014448829	7.62868E-38	-1.829336236
857	-0.150549288	1.4986E-38	-1.567081782
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860	-0.99394725	4.44192E-42	-0.712365849
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868	0.374681787	6.59577E-37	-2.498431327
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877	0.341810322	2.007E-37	-2.383773114
878	0.687646571	4.64795E-36	-3.290111007
879	1.452623474	5.49797E-33	-6.729442009
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887	-1.263529614	2.04161E-44	-0.516120168

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889	1.162173561	1.41292E-34	-5.054916397
890	1.069950656	5.38907E-35	-4.627304528
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905	-0.263681537	4.04527E-41	-1.273464225
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908	-0.218863068	4.57435E-41	-1.320529232
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917	-1.282383578	6.95036E-46	-0.467934513
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928	-0.49968221	4.04541E-43	-0.965825064
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