Sampling Methods - A Practical Activity (1 of 2) - Fish

You will need:
the .tns file on your handheld from the CIMT Statistics folder, called 'p135 Fish'.
or access to the RStudio Cloud file called '05 Sampling – Fish'

TI-Nspire skills needed:
randInt(3,17) will generate a single random integer between 3 and 17 inclusive
randInt(3,17,6) will generate a 6 random integers between 3 and 17 inclusive
mean(*listname*) will give the mean of a list of data called ***listname***
use the [var] key to quickly access names of lists of data
Use of [menu] > Statistics > Stat Calculations > One-Variable Statistics

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The Task
The image overleaf represents the fish caught in one trawl by a scientific research vessel. These are all shown at 1/10th scale. There are two main species of fish in the catch, that can be distinguished by the shapes of their tails - some are 'forked' and the rest are 'truncated'.

A scientist wants to better understand how the mean length of all fish varies, but she does not have time to measure the lengths of all 57 fish.

Instead she wishes to take a sample of 12 of them from which to take her measurements.

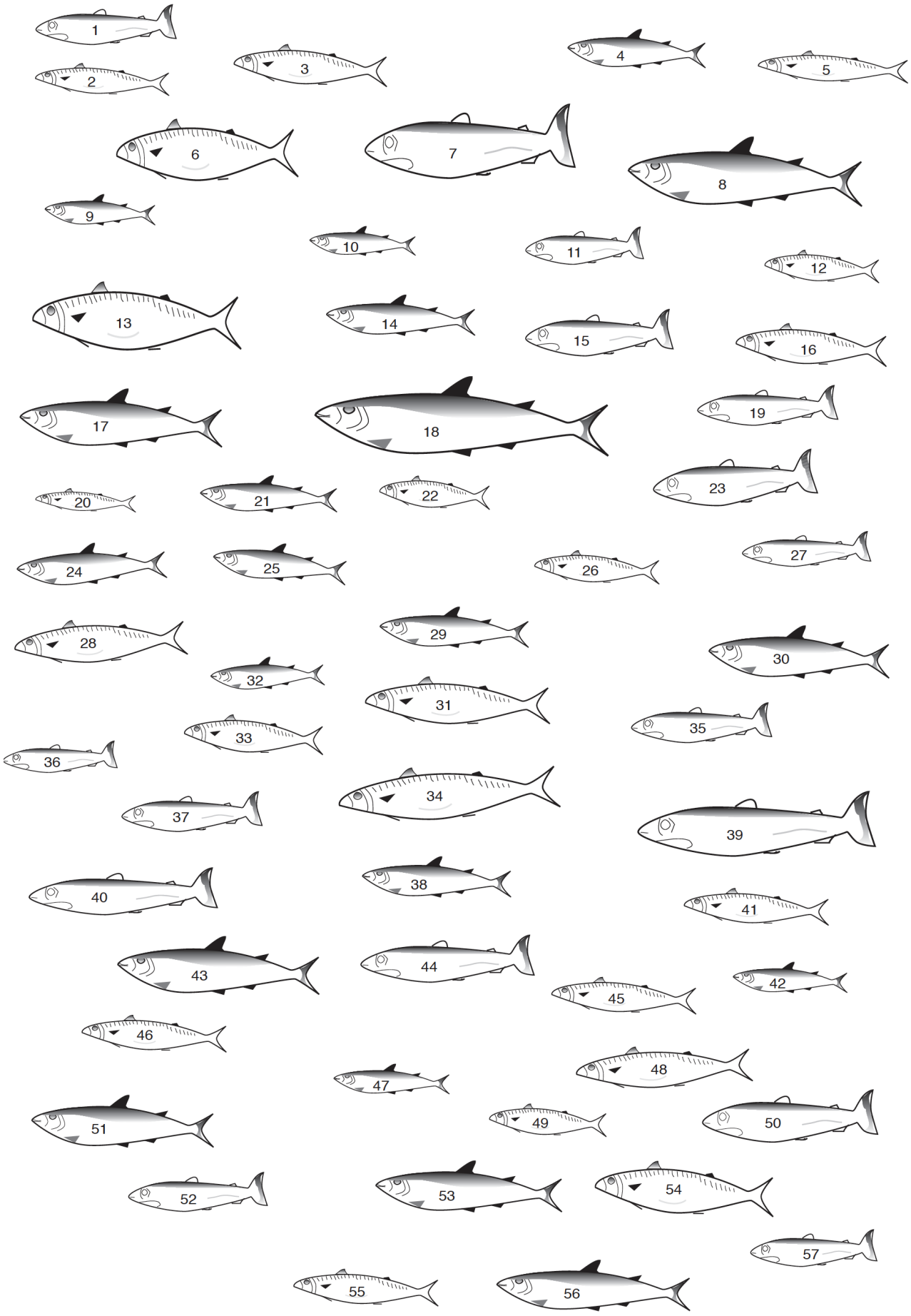
Listed below are several possible methods of sampling 12 fish from the catch of 57 fish.
Perform each sampling method, and calculate the mean length of fish for each sample.

Which sampling method gives the most consistent, representative result?

a) Convenience Sampling	Working from any corner, edge or starting number, select the first 12 fish that you come across.
b) Quota Sampling	Select 2 large fish, 7 medium fish and 3 small fish as you see fit.
c) Simple Random Sample	Use a random number generator on a calculator to give 12 numbers between 1 and 57 and select those numbered fish.
d) Systematic Sample	Use a random number generator on a calculator to generate a number between 1 and 57. Starting at that numbered fish, select every 5th numbered fish thereafter. eg. If you generated the number 24, then take fish 24, 29, 34 .... When you exceed the tree number 57, loop back to the start and continue until you have 12 fish in total.

e) Stratified Sample	Use your TI-Nspire to view a Data and Statistics graph of the Tail Shapes, and turn it from a dot plot into Bar Chart to see the total number of each type of tail. There should be 41 forked and 16 truncate. We need a total of 12 fish in our sample Calculate the number of each type of tail you need in your sample if the proportions of type of tail are to be preserved. eg 41 out of 57 should be forked, giving 8.63 fork tailed fish in your sample of 12. If a non-integer number of fish is calculated - as we have here - decide whether to round up, or down. Perform a simple random sample on each type of tailed fish to select the required number of fish of each type.
f) Single Stage Cluster Sampling	Divide the catch into 6 regions and number them 1 to 6 Use a random number generator on a calculator to generate one random number from 1 to 6 inclusive. This number is the region that you will use. Select every fish in the selected region.
g) Two Stage Cluster Sampling	Divide the catch into 6 regions and number them 1 to 6 Use a random number generator on a calculator to generate three random numbers from 1 to 6 inclusive. These three numbers are the three regions you will use. Use a simple random sample to select 4 fish from each of the three regions.

The Catch of 57 Fish



Sampling Methods - A Practical Activity (2 of 2) - Trees

You will need:
the .tns file on your handheld from the CIMT Statistics folder, called 'p039 Trees'
or access to the RStudio Cloud file called '05 Sampling – Trees'

Extra TI-Nspire skills needed:
sum(*listname*) will give the sum total of a list of data called ***listname***

The Task
A landowner has decided to sell a mature piece of deciduous woodland of 200 trees. He has asked a surveyor to come and assess the quality of the woods, but in the time available she can only carefully examine 25 trees. The landowner has a map of the woods on which they have numbered all the trees and indicated the variety. The surveyor says that the following details will be needed for each of 25 trees:

(i) the girth
(ii) the age
(iii) whether it suffers from a major disease
(iv) the approximate height

From this information it is possible to estimate the value of the trees as timber.
The surveyor and landowner discuss various methods which might be used to select the sample of 25 trees and they are listed below.

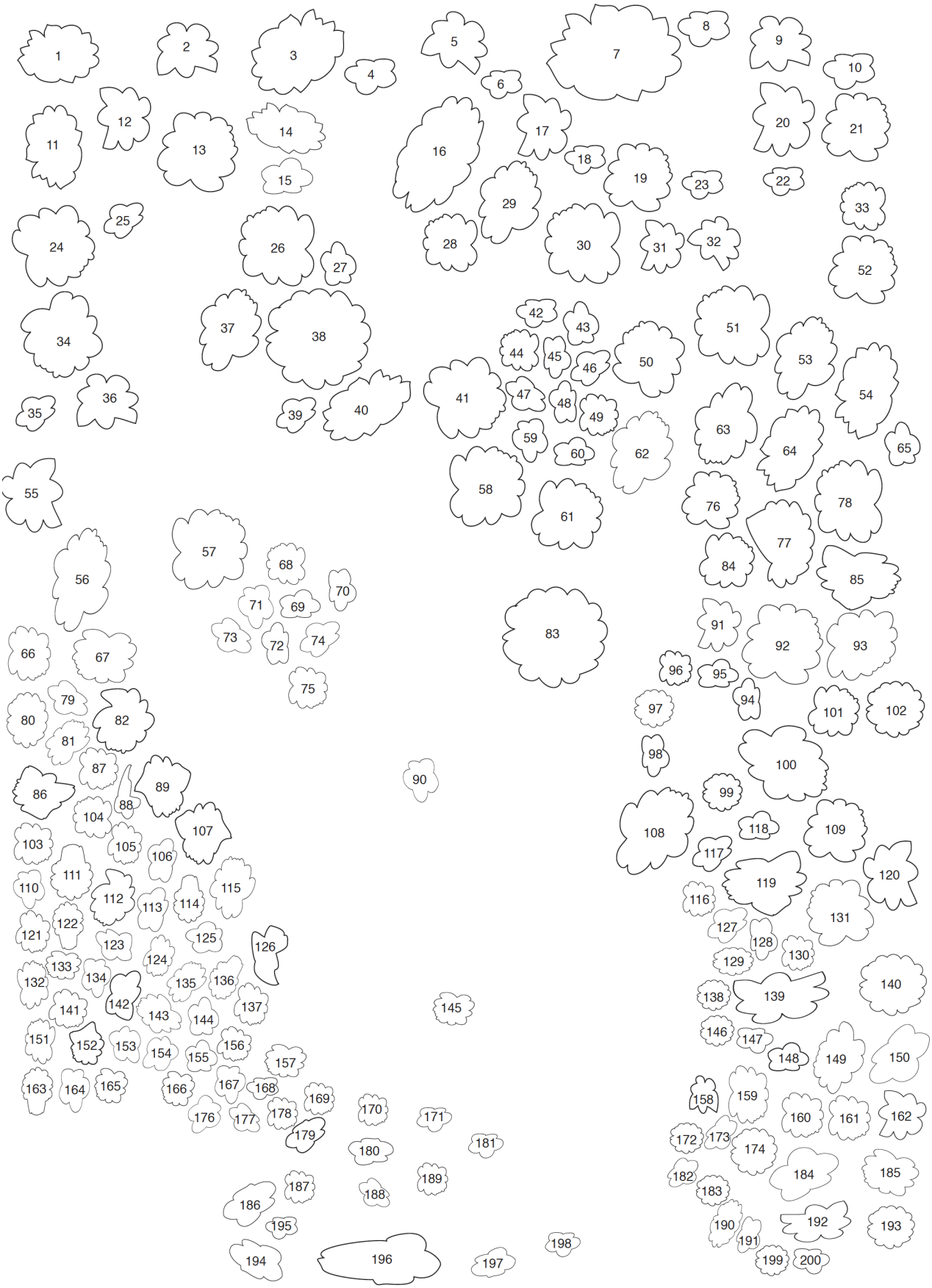
Perform each sampling method, and then calculate the total value of your sample and thus estimate the total value of all of the trees in the woodland by each method.

Which sampling method gives the most consistent, representative result?

a) Convenience Sampling	Working from any corner, edge or starting number, select the first 25 trees that you come across.
b) Questionable Random Sample	Drop a drawing pin on the map and select the tree nearest to the point of the pin. Repeat 25 times.
c) Simple Random Sample	Use a random number generator on a calculator to give 25 numbers between 1 and 200 and select those numbered trees.
d) Systematic Sampling	Use a random number generator on a calculator to give one number between 1 and 200. Starting at that numbered tree, select every 8^{th} numbered tree thereafter. eg. if starting at number 77, then take tree 77, 85, 93 .... When you exceed the tree number 200, loop back to the start and continue until you have 25 trees in total.

e) Stratified Sampling	Use your TI-Nspire to view a Data and Statistics graph of the type of tree, and turn it from a dot plot into bar chart to see the total number of each type of tree. There should be 52 Beech, 66 Birch, etc, etc We need a total of 25 trees in our sample. Calculate the number of each type of tree you need in your sample if the proportions of type of tree in the sample are to match those in the population eg 52 out of 200 should be Beech, giving 6.5 Beech trees in your sample of 25. If a non-integer number of trees is calculated, decide whether to round up, or down. Perform a simple random sample on each type of tree to select the required number of trees of each type.
f) Single Stage Cluster Sampling	Divide the woodland into 8 rectangular regions and number them 1 to 8. Use a random number generator on a calculator to give two random numbers from 1 to 8 inclusive. These two numbers are the two regions you will use. Select every tree from each of the two regions.
g) Two Stage Cluster Sampling	Divide the woodland into 8 rectangular regions and number them 1 to 8 Use a random number generator on a calculator to generate three random numbers from 1 to 8 inclusive. These three numbers are the three regions you will use. Use a simple random sample to select 9 trees from each of the three regions. This will give a sample of size 27, rather than 25.

Map of the Woodland



Data on all 200 Trees

Tree	Type	Girth	Age	Disease	Height	Value
1	Oak	2.1	80	0	7	120
2	Elm	1.8	65	0	6	90
3	Oak	3.5	115	0	8	200
4	Birch	0.8	20	0	3	0
5	Elm	1.9	65	0	6	95
6	Birch	0.6	18	0	3	0
7	Oak	4.6	150	0	8	300
8	Birch	0.7	19	1	3	0
9	Elm	1.7	60	1	5	0
10	Birch	0.8	21	0	2	0
11	Elm	1.7	70	0	6	80
12	Elm	1.7	72	0	6	80
13	Oak	2.1	90	0	7	120
14	Yew	2.3	130	0	7	300
15	Birch	0.7	20	1	3	0
16	Oak	4.5	145	0	7	240
17	Elm	2.1	75	0	6	90
18	Birch	0.7	18	0	3	0
19	Oak	3.2	108	0	8	180
20	Elm	1.7	67	1	6	0
21	Elm	1.6	65	1	6	20
22	Birch	0.7	18	1	3	0
23	Birch	0.6	15	0	2	0
24	Oak	2.9	102	0	7	115
25	Birch	0.6	21	0	3	0
26	Oak	3.1	110	0	8	175
27	Birch	0.9	23	1	3	0
28	Elm	1.8	74	0	6	90
29	Oak	3.2	110	0	8	170
30	Oak	3.8	120	0	9	195
31	Elm	2.0	75	1	6	0
32	Elm	2.3	75	1	7	30
33	Elm	2.2	75	1	7	0
34	Elm	2.6	80	0	7	90
35	Birch	0.6	20	0	3	0
36	Elm	2.5	78	0	7	95
37	Elm	2.8	85	0	7	100
38	Oak	3.7	116	1	8	80
39	Birch	0.7	23	1	3	0
40	Elm	2.8	80	0	7	95
41	Elm	3.3	95	0	7	110
42	Birch	0.6	21	0	3	0
43	Birch	0.6	20	0	3	0
44	Birch	0.5	17	0	2	0
45	Birch	0.6	22	0	3	0
46	Birch	0.6	21	1	3	0
47	Birch	0.6	20	0	3	0
48	Birch	0.6	21	1	3	0
49	Birch	0.5	18	0	3	0
50	Elm	3.5	98	0	7	120
51	Oak	4.1	120	0	8	180
52	Oak	3.9	115	0	7	165
53	Oak	3.1	85	0	7	135
54	Oak	4.1	118	0	8	170
55	Elm	2.8	80	0	7	95
56	Oak	4.0	118	0	8	170
57	Yew	4.7	120	0	9	280
58	Elm	3.3	90	0	6	100
59	Birch	0.6	21	0	3	0
60	Birch	0.6	20	0	3	0
61	Elm	3.2	85	0	6	80
62	Elm	3.2	88	0	6	80
63	Oak	3.5	108	0	8	150
64	Oak	3.4	105	0	8	145
65	Elm	2.1	45	0	6	60
66	Beech	2.5	55	0	5	70
67	Oak	3.0	90	0	7	130
68	Birch	0.7	23	0	3	0
69	Birch	0.6	22	0	3	0
70	Birch	0.6	22	1	3	0
71	Birch	0.6	21	0	3	0
72	Birch	0.6	20	1	3	0
73	Birch	0.7	22	0	3	0
74	Birch	0.6	21	0	3	0
75	Birch	0.6	21	0	3	0
76	Elm	2.9	81	0	7	90
77	Oak	4.3	125	0	8	190
78	Oak	4.4	127	0	8	195
79	Beech	2.4	55	0	5	70
80	Beech	2.6	55	0	5	75
81	Beech	2.4	55	0	5	70
82	Oak	3.5	98	0	7	150
83	Yew	5.0	150	0	9	300
84	Elm	2.8	78	0	7	85
85	Oak	4.3	125	0	8	185
86	Beech	2.6	55	0	6	80
87	Beech	2.5	55	0	5	75
88	Beech	2.5	55	0	5	75
89	Oak	3.6	100	0	7	145
90	Beech	2.9	80	0	7	90
91	Elm	2.8	81	0	7	85
92	Oak	3.4	102	0	7	150
93	Oak	3.6	102	0	7	150
94	Birch	0.6	21	0	3	0
95	Birch	0.6	20	0	3	0
96	Birch	0.5	18	0	3	0
97	Birch	0.6	20	0	3	0
98	Birch	0.6	21	1	3	0
99	Birch	0.6	20	1	3	0
100	Elm	2.9	80	1	7	20
101	Elm	2.8	83	1	7	0
102	Elm	2.7	80	1	7	15
103	Beech	2.6	55	0	7	75
104	Beech	2.5	55	0	7	70
105	Beech	2.4	55	0	7	60
106	Beech	2.4	55	0	7	60
107	Oak	4.2	102	1	8	30
108	Elm	4.3	98	0	8	110
109	Elm	3.1	84	1	8	15
110	Beech	2.5	55	0	7	75
111	Beech	2.4	55	1	7	10
112	Beech	2.5	55	0	7	70
113	Beech	2.5	55	0	7	75
114	Beech	2.4	55	0	7	70
115	Oak	3.9	95	0	8	130
116	Birch	0.6	20	0	3	0
117	Birch	0.6	19	0	3	0
118	Birch	0.7	22	0	3	0
119	Yew	4.1	110	0	8	200
120	Elm	3.3	85	0	8	120
121	Beech	2.6	55	0	7	75
122	Beech	2.5	55	0	7	70
123	Beech	2.5	55	0	7	70
124	Beech	2.5	55	0	7	70
125	Beech	2.6	55	0	7	75
126	Oak	3.7	90	0	8	125
127	Birch	0.6	20	0	3	0
128	Birch	0.7	21	0	3	0
129	Birch	0.6	20	0	3	0
130	Birch	0.6	20	0	3	0
131	Elm	3.5	90	0	8	130
132	Beech	2.5	55	0	7	75
133	Beech	2.4	55	0	7	70
134	Beech	2.5	55	0	7	75
135	Beech	2.3	55	0	6	60
136	Beech	2.5	55	0	7	75
137	Beech	2.5	55	0	7	75
138	Birch	0.6	20	0	3	0
139	Beech	2.2	48	0	6	60
140	Elm	3.7	87	1	7	10
141	Beech	2.5	55	1	7	20
142	Beech	2.6	55	0	7	80
143	Beech	2.5	55	0	7	75
144	Beech	2.5	55	0	7	75
145	Beech	2.3	47	0	6	60
146	Birch	0.6	20	0	3	0
147	Birch	0.7	22	1	3	0
148	Oak	3.8	85	0	7	140
149	Oak	3.6	85	0	7	130
150	Oak	4.1	85	0	8	150
151	Beech	2.5	55	0	7	75
152	Beech	2.5	55	0	7	75
153	Beech	2.4	55	0	7	70
154	Beech	2.5	55	0	7	75
155	Beech	2.5	55	1	7	15
156	Beech	2.4	55	0	7	70
157	Elm	3.9	85	0	8	80
158	Birch	0.6	20	0	3	0
159	Oak	4.3	85	0	7	160
160	Oak	3.9	85	0	7	150
161	Oak	3.8	85	0	7	150
162	Oak	3.8	85	0	7	150
163	Beech	2.4	55	0	7	70
164	Beech	2.5	55	0	7	75
165	Beech	2.4	55	0	7	70
166	Beech	2.5	55	0	7	75
167	Beech	2.5	55	0	7	75
168	Birch	0.6	19	0	3	0
169	Birch	0.6	20	0	3	0
170	Birch	0.6	19	0	3	0
171	Birch	0.6	20	1	3	0
172	Birch	0.5	17	1	3	0
173	Birch	0.6	18	0	3	0
174	Elm	3.2	76	1	7	10
175	Beech	2.5	55	0	7	75
176	Beech	2.7	55	0	7	80
177	Birch	0.7	21	0	3	0
178	Birch	0.6	19	0	3	0
179	Beech	1.4	22	0	4	15
180	Birch	0.6	19	0	3	0
181	Birch	0.6	18	0	3	0
182	Birch	0.6	19	0	3	0
183	Birch	0.6	19	0	3	0
184	Elm	3.5	83	0	7	85
185	Elm	2.9	72	0	7	75
186	Beech	2.5	55	0	7	75
187	Birch	0.6	20	0	3	0
188	Birch	0.5	15	0	2	0
189	Beech	1.7	31	0	5	30
190	Beech	1.6	28	0	4	20
191	Birch	0.6	17	0	3	0
192	Elm	2.7	54	0	5	30
193	Elm	2.9	51	0	5	30
194	Elm	2.9	48	0	5	30
195	Birch	0.6	15	1	3	0
196	Yew	4.2	124	0	8	200
197	Beech	1.9	38	0	6	35
198	Birch	0.6	19	0	3	0
199	Birch	0.6	18	0	3	0
200	Birch	0.6	21	0	3	0