Sawlog Weights for
APPALACHIAN HARDWOODS

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FOREWORD

THE TABLES are presented in this paper as reference material needed as a foundation for further work in the field of hardwood log weights. Such work may be undertaken by researchers, engineers, and equipment designers in the form of formal and informal studies, or by timbermen in the normal course of action to improve their operations.

THE AUTHOR

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CONTENTS

A FOUNDATION

LOG WEIGHT instead of volume? Timberland owners, foresters, loggers, and sawmill operators have suggested a variety of ways to apply log weights instead of log-volume measurements from customary scaling procedures. Some would use log weight to estimate board-foot content. Others would apply log weights in designing log-handling machines or to determine load size on trucks. But regardless of their intentions, users will first need to know the relationships between log weight in pounds and log size and species. So we developed basic log-weight equations for the major Appalachian hardwood log species and, from these equations, constructed log-weight tables that could form the foundation for a variety of systems using log weight.

The few published sets of sawlog-weight tables for Appalachian hardwoods give estimates only for broad diameter groups of logs, not for specific log-size classes. These tables are not sufficiently detailed for many of the suggested applications. Most weight tables for a given species of logs are based on specific gravity, moisture content, and proportion of sapwood—but not on actual weights. They do not consider many other factors that influence weight, such as bark, rot, and external irregularities. Therefore our study was designed to construct weight tables based on actual log measurements and weights. And, while not directly measuring the many factors affecting weights, the results reflect the average influence of these factors.

Any practical use of weight data and detailed methods of adjusting the tables to a particular situation will be discussed in subsequent publications. The weight-predicting equations and tables are presented here as an important ingredient of procedures that should be developed if weight is to be used as a form of log measurement. The equations and tables are also for those persons who might wish to apply them to situations of personal interest involving log weights.

THE STUDY

Data Collection

The study was conducted at six mills in Maryland, West Virginia, and Virginia (fig. 1). We weighed 4,800 logs representing 15 commercially important Appalachian hardwood species. Log weights were taken at four mills during the fall season and at two other mills the following spring.

For each log, we recorded gross weight, length, diameter of small end (outside bark), and bark thickness. The weight was taken to the nearest 10 pounds, length to the nearest 1/10 of a foot, and diameter and bark thickness to the nearest 1/10 of an inch. The bark thickness was necessary to obtain scaling diameter (diameter inside bark), because all diameter measurements were taken with a diameter tape. A hydraulic load cell scale hooked in a crane line was used for weighing (fig. 2).

In collecting the field data, any woods-run log arriving at the yard was acceptable for measurement as long as it had been cut within 1 week of sampling. Since we weighed

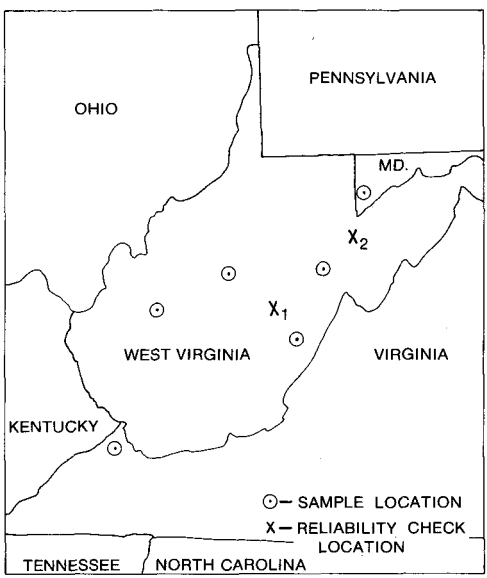
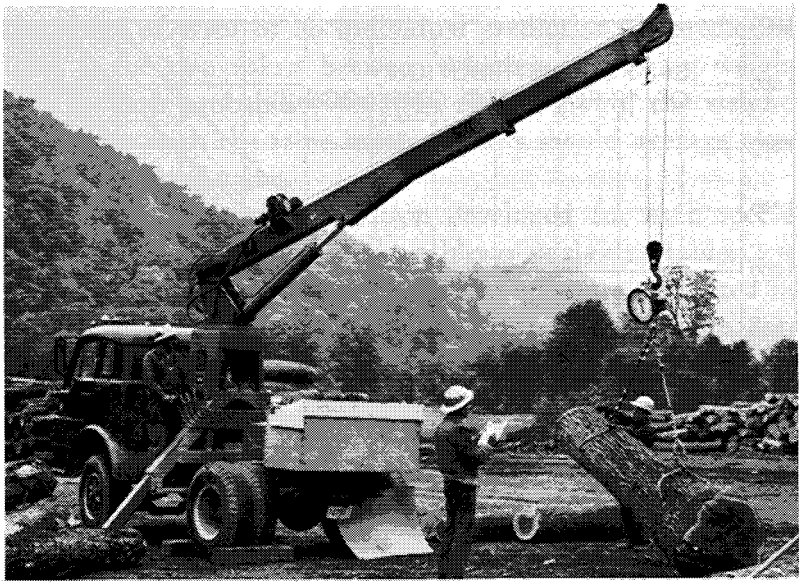


Figure 1.—Sampling area.

Figure 2.—A hydraulic load cell scale hooked in a crane line was used to weigh the logs.



logs at the mill yard, the sample included only logs acceptable to that mill.

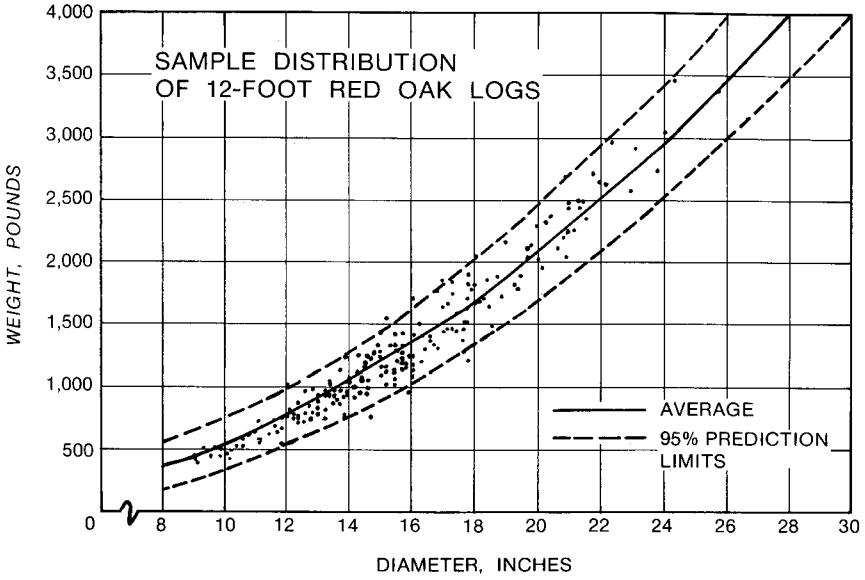
Construction of Tables

Our objective was to construct log-weight tables for each species considered. This required a prediction equation using the factors selected for measurement, which would give a reasonable and reliable predicted log-weight value based on the factor selected for measurement. To do this, regression analyses seemed adequate.

Plots of sawlog weight over the diameter by log lengths showed a slight curvilinear trend (fig. 3). The log diameter (D) and the square of the diameter times the length (D^2L) have been used successfully under similar circumstances.[1]

[1] Adams, Edward L. The development of a computer program to construct weight tables for the variable plot cruising of pulpwood. Unpublished Masters thesis on file at the School of Forestry, W. Va. Univ., Morgantown. 1969.

Figure 3.—Distribution of sample logs, average sawlog weight, and 95 percent prediction limits for 12-foot red oak logs.



Therefore, the following general model was used as a basis of our regression analysis:

$$W_i = b_o + b_1 D_i + b_2 (D_i^2 L_i) + e_i$$

where:

W_i = sawlog weight in pounds.
b_o, b_1, b_2 = population regression coefficients.
D_i = diameter inside bark at small end, in inches.
L_i = length in feet.
e_i = experimental error.

The plotted data (fig. 3) also show that the variation in log weights increase as diameter increases. This pattern suggests the use of weighted multiple regression, and based on closer examination of the data, we decided that the inverse of the square of the diameter ($1/D^2$) would be an appropriate weighting factor for our equation.

We also determined the 95-percent confidence intervals

for predictions using the weighted regressions.[2] The upper and lower limits of the intervals show, on a probability basis, the range of error of an individual prediction. A prediction limit is the two values between which a future log weight will be with probability 0.95. In the long run, the weights of all logs with the same measurements should average close to the predicted value.

From the regression equation developed for each species (table 1), we constructed the tables of weights (tables 2 to 16). The predicted average sawlog weights are tabulated by 1-inch diameter classes (inside bark, small end) from 8 to 30 inches and by 1-foot length classes from 8 to 18 feet. The

[2] Ostle, Bernard. Statistics in research. Ed. 2, 585 pp., Ames, Iowa: Iowa State Univ. Press. 1963.

Table 1.—Regression equations and the R^2 and standard error of estimate associated with each

Species	Prediction equations	R^2	Standard error of estimate
			Lbs.
Ash, white	$W = 66.0433 - 6.8790D + 0.3433D^2L$	0.79	9.2
Basswood	$W = 125.6829 - 13.0288D + 0.3488D^2L$	.86	7.2
Beech	$W = 313.2024 - 29.4343D + 0.4372D^2L$	.93	7.3
Birch (yellow and black)	$W = 6.9273 + 6.5366D + 0.4086D^2L$	.85	9.8
Black gum	$W = 195.5815 - 7.8292D + 0.3826D^2L$	.82	11.1
Cherry, black	$W = 105.1938 - 18.2341D + 0.4081D^2L$	.92	6.3
Cucumber	$W = 38.9477 - 7.7847D + 0.3534D^2L$	.88	6.4
Hickory	$W = 190.1192 - 18.7348D + 0.4482D^2L$	.86	9.2
Locust, black	$W = 48.7871 + 2.1538D + 0.3148D^2L$	.65	9.0
Maple, red	$W = 289.0249 - 29.4911D + 0.4045D^2L$	.86	8.8
Maple, sugar	$W = 191.5229 - 12.9985D + 0.3917D^2L$	.84	11.0
Oak, chestnut	$W = 183.3447 - 15.9959D + 0.4516D^2L$	.85	9.0
Oak, red group	$W = 169.0737 - 18.7765D + 0.4736D^2L$	.89	10.1
Oak, white	$W = 224.7721 - 24.9150D + 0.4677D^2L$	.85	10.4
Yellow-poplar	$W = 144.0939 - 11.1559D + 0.3553D^2L$	.83	8.3

weights given under any given foot measurement are the weights of a log for that exact diameter and length measurement. For the weight of a log whose length or diameter is not on the exact foot or inch mark, the formula can be used to calculate a predicted log weight.

In tables 2 through 16, the half-widths of the 95-percent prediction intervals are given for 12-foot logs. These half-widths sometimes differ slightly from those for other length logs in the same diameter class; however, in most cases, the difference is less than 2 percent and, for all practical purposes, is negligible.

Although the prediction intervals appear quite wide, this can be attributed to the interaction of many factors, such as: site, surface irregularities (knots, burls, etc.), bark (weight can change by as much as 15 percent depending on amount of bark lost in handling), taper, location of log in tree, percent of sapwood, and decay. Density and moisture content, which in turn depend on age, dominance, position in tree, rate of growth, and location, have a great effect on weight, varying as much within a stand as between localities.

It is possible that the prediction interval could be improved by including more variables. However, R^2 values and values for the standard error of the estimates (table 1) indicate that, from a statistical standpoint, we have a satisfactory model. It is also satisfactory in a practical sense, as it is desirable to keep the input relatively simple and easy to obtain. The increased time and expense of adding other measured characteristics would not be worth the increase in precision of the answer.

The dark line in the body of each weight table encompasses weight based on 90 percent of the logs we measured. The values outside of the dark line are based on the remaining 10 percent of the field samples.

WHITE ASH (*Fraxinus americana L.*)

Table 2.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 66.0433 - 6.8790D + 0.3433D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	186	208	230	252	274	296	318	340	362	384	406	148
9	226	254	282	310	337	365	393	421	449	476	504	164
10	271	306	340	374	409	443	477	512	546	580	615	182
11	322	364	405	447	488	530	571	613	655	696	738	199
12	378	428	477	527	576	626	675	725	774	823	873	217
13	440	498	556	614	672	730	788	846	904	962	1,020	235
14	508	575	642	709	777	844	911	979	1,046	1,113	1,180	254
15	580	658	735	812	889	967	1,044	1,121	1,198	1,276	1,353	272
16	659	746	834	922	1,010	1,098	1,186	1,274	1,362	1,450	1,537	290
17	742	842	941	1,040	1,139	1,238	1,338	1,437	1,536	1,635	1,735	309
18	832	943	1,054	1,165	1,277	1,388	1,499	1,610	1,721	1,833	1,944	328
19	926	1,050	1,174	1,298	1,422	1,546	1,670	1,794	1,918	2,042	2,166	346
20	1,027	1,164	1,301	1,439	1,576	1,713	1,851	1,988	2,125	2,263	2,400	365
21	1,132	1,284	1,435	1,587	1,738	1,889	2,041	2,192	2,344	2,495	2,646	384
22	1,244	1,410	1,576	1,742	1,908	2,074	2,241	2,407	2,573	2,739	2,905	403
23	1,360	1,542	1,723	1,905	2,087	2,268	2,450	2,632	2,813	2,995	3,176	423
24	1,482	1,680	1,878	2,076	2,273	2,471	2,669	2,867	3,064	3,262	3,460	442
25	1,610	1,825	2,039	2,254	2,468	2,683	2,898	3,112	3,327	3,541	3,756	462
26	1,743	1,975	2,208	2,440	2,672	2,904	3,136	3,368	3,600	3,832	4,064	482
27	1,882	2,132	2,383	2,633	2,883	3,133	3,384	3,634	3,884	4,135	4,385	502
28	2,026	2,295	2,565	2,834	3,103	3,372	3,641	3,910	4,180	4,449	4,718	522
29	2,176	2,465	2,753	3,042	3,331	3,620	3,908	4,197	4,486	4,774	5,063	543
30	2,331	2,640	2,949	3,258	3,567	3,876	4,185	4,494	4,803	5,112	5,421	564

[1] Add to and subtract from weight to obtain range interval.

BASSWOOD *(Tilia spp. L.)*

Table 3.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 125.6829 - 13.0288D + 0.3488D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	200	222	244	267	289	311	334	356	378	400	423	114
9	234	262	290	319	347	375	404	432	460	488	517	127
10	274	309	344	379	414	448	483	518	553	588	623	141
11	320	362	404	446	488	531	573	615	657	699	742	155
12	371	421	471	521	572	622	672	722	773	823	873	169
13	427	486	545	604	663	722	781	840	899	958	1,017	183
14	490	558	627	695	763	832	900	968	1,037	1,105	1,173	197
15	558	636	715	793	872	950	1,029	1,107	1,186	1,264	1,343	211
16	631	720	810	899	988	1,078	1,167	1,256	1,346	1,435	1,524	226
17	710	811	912	1,013	1,113	1,214	1,315	1,416	1,517	1,618	1,718	240
18	795	908	1,021	1,134	1,247	1,360	1,473	1,586	1,699	1,812	1,925	254
19	885	1,011	1,137	1,263	1,389	1,515	1,641	1,767	1,893	2,018	2,144	269
20	981	1,120	1,260	1,400	1,539	1,679	1,818	1,958	2,097	2,237	2,376	283
21	1,082	1,236	1,390	1,544	1,698	1,851	2,005	2,159	2,313	2,467	2,621	297
22	1,189	1,358	1,527	1,696	1,865	2,033	2,202	2,371	2,540	2,709	2,878	312
23	1,302	1,486	1,671	1,855	2,040	2,224	2,409	2,594	2,778	2,963	3,147	326
24	1,420	1,621	1,822	2,023	2,224	2,425	2,626	2,826	3,027	3,228	3,429	340
25	1,544	1,762	1,980	2,198	2,416	2,634	2,852	3,070	3,288	3,506	3,724	355
26	1,673	1,909	2,145	2,380	2,616	2,852	3,088	3,324	3,559	3,795	4,031	370
27	1,808	2,062	2,316	2,571	2,825	3,079	3,334	3,588	3,842	4,097	4,351	384
28	1,948	2,222	2,495	2,769	3,042	3,316	3,589	3,863	4,136	4,410	4,683	399
29	2,094	2,388	2,681	2,974	3,268	3,561	3,855	4,148	4,441	4,735	5,028	414
30	2,246	2,560	2,874	3,188	3,502	3,816	4,130	4,444	4,758	5,072	5,386	429

[1] Add to and subtract from weight to obtain range interval.

BEECH (*Fagus grandifolia Ehrh.*)

Table 4.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 313.2024 - 29.4343D + 0.4372D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	301	329	357	385	413	441	469	497	525	553	581	122
9	331	367	402	437	473	508	544	579	614	650	685	133
10	368	412	456	499	543	587	630	674	718	762	805	146
11	412	465	518	571	624	677	730	782	835	888	941	159
12	463	526	589	652	715	778	841	904	967	1,030	1,093	173
13	521	595	669	743	817	891	964	1,038	1,112	1,186	1,260	187
14	586	672	758	843	929	1,015	1,100	1,186	1,272	1,357	1,443	201
15	658	757	855	953	1,052	1,150	1,248	1,347	1,445	1,544	1,642	216
16	737	849	961	1,073	1,185	1,297	1,409	1,521	1,633	1,744	1,856	230
17	823	949	1,076	1,202	1,329	1,455	1,581	1,708	1,834	1,960	2,087	245
18	916	1,058	1,199	1,341	1,483	1,624	1,766	1,908	2,049	2,191	2,333	259
19	1,016	1,174	1,332	1,490	1,647	1,805	1,963	2,121	2,279	2,437	2,594	274
20	1,123	1,298	1,473	1,648	1,823	1,997	2,172	2,347	2,522	2,697	2,872	288
21	1,237	1,430	1,623	1,815	2,008	2,201	2,394	2,587	2,780	2,972	3,165	303
22	1,358	1,570	1,781	1,993	2,204	2,416	2,628	2,839	3,051	3,262	3,474	318
23	1,486	1,717	1,949	2,180	2,411	2,642	2,874	3,105	3,336	3,568	3,799	332
24	1,621	1,873	2,125	2,376	2,628	2,880	3,132	3,384	3,636	3,887	4,139	347
25	1,763	2,036	2,309	2,583	2,856	3,129	3,402	3,676	3,949	4,222	4,495	362
26	1,912	2,207	2,503	2,798	3,094	3,390	3,685	3,981	4,276	4,572	4,867	377
27	2,068	2,386	2,705	3,024	3,343	3,661	3,980	4,299	4,618	4,936	5,255	392
28	2,231	2,573	2,916	3,259	3,602	3,945	4,287	4,630	4,973	5,316	5,658	407
29	2,401	2,768	3,136	3,504	3,871	4,239	4,607	4,974	5,342	5,710	6,078	422
30	2,578	2,971	3,365	3,758	4,152	4,545	4,938	5,332	5,725	6,119	6,512	437

[1] Add to and subtract from weight to obtain range interval.

BIRCH (yellow and black) *(Betula spp. L.)*

Table 5.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 6.9273 + 6.5366D + 0.4086D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	268	294	320	346	373	399	425	451	477	503	529	169
9	330	363	396	429	462	496	529	562	595	628	661	184
10	399	440	480	521	562	603	644	685	726	766	807	200
11	474	523	578	622	672	721	771	820	869	919	968	219
12	556	614	673	732	791	850	909	968	1,026	1,085	1,144	238
13	644	713	782	851	920	989	1,058	1,127	1,196	1,265	1,334	258
14	739	819	899	979	1,059	1,139	1,219	1,299	1,379	1,460	1,540	278
15	840	932	1,024	1,116	1,208	1,300	1,392	1,484	1,576	1,667	1,759	298
16	948	1,053	1,157	1,262	1,366	1,471	1,576	1,680	1,785	1,889	1,994	319
17	1,062	1,180	1,298	1,417	1,535	1,653	1,771	1,889	2,007	2,125	2,243	340
18	1,183	1,316	1,448	1,580	1,713	1,845	1,978	2,110	2,242	2,375	2,507	360
19	1,311	1,458	1,606	1,753	1,901	2,048	2,196	2,343	2,491	2,638	2,786	381
20	1,445	1,608	1,772	1,935	2,099	2,262	2,426	2,589	2,752	2,916	3,079	402
21	1,585	1,766	1,946	2,126	2,306	2,486	2,667	2,847	3,027	3,207	3,387	424
22	1,732	1,930	2,128	2,326	2,524	2,721	2,919	3,117	3,315	3,512	3,710	445
23	1,886	2,102	2,318	2,535	2,751	2,967	3,183	3,399	3,615	3,832	4,048	467
24	2,046	2,282	2,517	2,752	2,988	3,223	3,459	3,694	3,929	4,165	4,400	490
25	2,213	2,468	2,724	2,979	3,235	3,490	3,745	4,001	4,256	4,512	4,767	513
26	2,386	2,663	2,939	3,215	3,491	3,767	4,044	4,320	4,596	4,872	5,149	536
27	2,566	2,864	3,162	3,460	3,758	4,056	4,353	4,651	4,949	5,247	5,545	560
28	2,752	3,073	3,393	3,714	4,034	4,354	4,675	4,995	5,315	5,636	5,956	585
29	2,945	3,289	3,633	3,976	4,320	4,664	5,007	5,351	5,695	6,038	6,382	611
30	3,145	3,512	3,880	4,248	4,616	4,984	5,351	5,719	6,087	6,455	6,822	637

[1] Add to and subtract from weight to obtain range interval.

BLACK GUM *(Nyssa sylvatica Marsh.)*

Table 6.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 195.5815 - 7.8292D + 0.3826D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	328	353	377	402	426	451	475	500	524	549	573	197
9	373	404	435	466	497	528	558	589	620	651	682	211
10	423	461	499	538	576	614	652	691	729	767	805	227
11	479	526	572	618	665	711	757	803	850	896	942	247
12	542	597	652	707	762	817	872	928	983	1,038	1,093	268
13	611	675	740	805	869	934	999	1,063	1,128	1,193	1,257	290
14	685	760	835	910	985	1,060	1,135	1,210	1,285	1,360	1,435	313
15	766	852	939	1,025	1,111	1,197	1,283	1,369	1,455	1,541	1,627	337
16	853	951	1,049	1,147	1,245	1,343	1,441	1,539	1,637	1,735	1,833	361
17	947	1,057	1,168	1,278	1,389	1,499	1,610	1,721	1,831	1,942	2,052	385
18	1,046	1,170	1,294	1,418	1,542	1,666	1,790	1,914	2,038	2,162	2,286	409
19	1,151	1,289	1,428	1,566	1,704	1,842	1,980	2,118	2,256	2,394	2,533	433
20	1,263	1,416	1,569	1,722	1,875	2,028	2,181	2,334	2,487	2,640	2,793	457
21	1,381	1,549	1,718	1,887	2,055	2,224	2,393	2,562	2,730	2,899	3,068	481
22	1,504	1,689	1,875	2,060	2,245	2,430	2,615	2,801	2,986	3,171	3,356	505
23	1,634	1,837	2,039	2,241	2,444	2,646	2,849	3,051	3,253	3,456	3,658	529
24	1,770	1,991	2,211	2,431	2,652	2,872	3,093	3,313	3,533	3,754	3,974	554
25	1,912	2,152	2,391	2,630	2,869	3,108	3,347	3,586	3,825	4,065	4,304	578
26	2,061	2,319	2,578	2,837	3,095	3,354	3,613	3,871	4,130	4,388	4,647	602
27	2,215	2,494	2,773	3,052	3,331	3,610	3,889	4,168	4,446	4,725	5,004	627
28	2,376	2,676	2,976	3,275	3,575	3,875	4,175	4,475	4,775	5,075	5,375	652
29	2,542	2,864	3,186	3,508	3,829	4,151	4,473	4,795	5,116	5,438	5,760	677
30	2,715	3,059	3,404	3,748	4,092	4,437	4,781	5,125	5,470	5,814	6,158	703

[1] Add to and subtract from weight to obtain range interval.

CHERRY, BLACK (*Prunus serotina Ehrh.*)

Table 7.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 105.1938 - 18.2341D + 0.4081D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	168	194	220	246	272	298	324	351	377	403	429	100
9	205	238	271	304	337	370	403	436	469	503	536	112
10	249	290	330	371	412	453	494	534	575	616	657	124
11	299	349	398	447	497	546	595	645	694	744	793	136
12	356	415	474	532	591	650	709	767	826	885	944	148
13	419	488	557	626	695	764	833	902	971	1,040	1,109	161
14	489	569	649	729	809	889	969	1,049	1,129	1,209	1,289	173
15	566	658	749	841	933	1,025	1,117	1,208	1,300	1,392	1,484	186
16	649	753	858	962	1,067	1,171	1,276	1,380	1,484	1,589	1,693	198
17	738	856	974	1,092	1,210	1,328	1,446	1,564	1,682	1,800	1,918	211
18	834	966	1,099	1,231	1,363	1,495	1,628	1,760	1,892	2,024	2,156	224
19	937	1,084	1,231	1,379	1,526	1,673	1,821	1,968	2,115	2,263	2,410	236
20	1,046	1,209	1,372	1,536	1,699	1,862	2,025	2,189	2,352	2,515	2,678	249
21	1,162	1,341	1,521	1,701	1,881	2,061	2,241	2,421	2,601	2,781	2,961	262
22	1,284	1,481	1,679	1,876	2,074	2,271	2,469	2,666	2,864	3,061	3,259	275
23	1,412	1,628	1,844	2,060	2,276	2,492	2,708	2,924	3,139	3,355	3,571	288
24	1,548	1,783	2,018	2,253	2,488	2,723	2,958	3,193	3,428	3,663	3,898	301
25	1,689	1,944	2,199	2,454	2,710	2,965	3,220	3,475	3,730	3,985	4,240	314
26	1,838	2,113	2,389	2,665	2,941	3,217	3,493	3,769	4,045	4,320	4,596	327
27	1,992	2,290	2,587	2,885	3,182	3,480	3,777	4,075	4,372	4,670	4,967	340
28	2,154	2,474	2,794	3,114	3,433	3,753	4,073	4,393	4,713	5,033	5,353	354
29	2,322	2,665	3,008	3,351	3,694	4,038	4,381	4,724	5,067	5,410	5,754	367
30	2,496	2,863	3,231	3,598	3,965	4,332	4,700	5,067	5,434	5,801	6,169	381

[1] Add to and subtract from weight to obtain range interval.

CUCUMBER *(Magnolia acuminata L.)*

Table 8.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 38.9477 - 7.7847D + 0.3534D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	157	180	202	225	248	270	293	315	338	361	383	101
9	197	226	255	283	312	341	369	398	426	455	484	113
10	243	279	314	349	385	420	455	491	526	561	597	125
11	295	338	380	423	466	509	552	594	637	680	723	137
12	352	403	454	505	556	607	658	708	759	810	861	150
13	415	475	535	594	654	714	773	833	893	953	1,012	162
14	484	553	622	691	761	830	899	969	1,038	1,107	1,176	175
15	558	637	717	796	876	955	1,035	1,114	1,194	1,274	1,353	188
16	638	728	819	909	1,000	1,090	1,181	1,271	1,362	1,452	1,542	200
17	723	825	928	1,030	1,132	1,234	1,336	1,438	1,540	1,642	1,745	213
18	814	929	1,043	1,158	1,272	1,387	1,501	1,616	1,730	1,845	1,959	226
19	911	1,039	1,166	1,294	1,422	1,549	1,677	1,804	1,932	2,059	2,187	239
20	1,014	1,155	1,296	1,438	1,579	1,721	1,862	2,003	2,145	2,286	2,427	252
21	1,122	1,278	1,434	1,589	1,745	1,901	2,057	2,213	2,369	2,525	2,680	265
22	1,236	1,407	1,578	1,749	1,920	2,091	2,262	2,433	2,604	2,775	2,946	278
23	1,355	1,542	1,729	1,916	2,103	2,290	2,477	2,664	2,851	3,038	3,225	291
24	1,480	1,684	1,887	2,091	2,294	2,498	2,702	2,905	3,109	3,312	3,516	305
25	1,611	1,832	2,053	2,274	2,495	2,715	2,936	3,157	3,378	3,599	3,820	318
26	1,747	1,986	2,225	2,464	2,703	2,942	3,181	3,420	3,659	3,898	4,136	332
27	1,889	2,147	2,405	2,662	2,920	3,178	3,435	3,693	3,951	4,208	4,466	346
28	2,037	2,314	2,591	2,868	3,145	3,423	3,700	3,977	4,254	4,531	4,808	360
29	2,191	2,488	2,785	3,082	3,379	3,677	3,974	4,271	4,568	4,866	5,163	374
30	2,350	2,668	2,986	3,304	3,622	3,940	4,258	4,576	4,894	5,212	5,530	380

[1] Add to and subtract from weight to obtain range interval.

HICKORY (*Carya spp.*)

Table 9.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 190.1192 - 18.7348D + 0.4482D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	269	298	327	355	384	413	441	470	499	527	556	147
9	311	348	384	420	457	493	529	566	602	638	674	163
10	361	406	450	495	540	585	630	675	719	764	809	181
11	417	472	526	580	634	689	743	797	851	905	960	198
12	481	546	610	675	739	804	868	933	997	1,062	1,127	216
13	552	628	704	779	855	931	1,007	1,082	1,158	1,234	1,310	234
14	630	718	806	894	982	1,069	1,157	1,245	1,333	1,421	1,509	252
15	715	816	917	1,018	1,119	1,220	1,320	1,421	1,522	1,623	1,724	270
16	808	923	1,037	1,152	1,267	1,381	1,496	1,611	1,726	1,840	1,955	289
17	907	1,037	1,166	1,296	1,426	1,555	1,685	1,814	1,944	2,073	2,203	307
18	1,014	1,159	1,305	1,450	1,595	1,740	1,885	2,031	2,176	2,321	2,466	325
19	1,128	1,290	1,452	1,613	1,775	1,937	2,099	2,261	2,422	2,584	2,746	344
20	1,249	1,428	1,608	1,787	1,966	2,146	2,325	2,504	2,683	2,863	3,042	362
21	1,377	1,575	1,773	1,970	2,168	2,366	2,563	2,761	2,959	3,156	3,354	380
22	1,513	1,730	1,947	2,164	2,381	2,598	2,815	3,031	3,248	3,465	3,682	399
23	1,656	1,893	2,130	2,367	2,604	2,841	3,078	3,315	3,552	3,789	4,027	417
24	1,805	2,063	2,322	2,580	2,838	3,096	3,354	3,612	3,871	4,129	4,387	435
25	1,962	2,242	2,523	2,803	3,083	3,363	3,643	3,923	4,203	4,483	4,764	454
26	2,126	2,429	2,732	3,035	3,338	3,641	3,944	4,247	4,550	4,853	5,156	472
27	2,298	2,624	2,951	3,278	3,605	3,931	4,258	4,585	4,912	5,238	5,565	491
28	2,476	2,828	3,179	3,530	3,882	4,233	4,585	4,936	5,287	5,639	5,990	510
29	2,662	3,039	3,416	3,793	4,170	4,547	4,923	5,300	5,677	6,054	6,431	592
30	2,855	3,258	3,661	4,065	4,468	4,872	5,275	5,678	6,082	6,485	6,889	547

[1] Add to and subtract from weight to obtain range interval.

LOCUST, BLACK *(Robinia pseudoacacia L.)*

Table 10.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 48.7871 + 2.1538D + 0.3148D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	227	247	267	287	307	327	348	368	388	408	428	145
9	272	297	323	348	374	399	425	450	476	501	527	162
10	322	353	385	416	448	479	511	542	574	605	637	180
11	377	415	453	491	529	567	605	643	681	720	758	198
12	437	482	527	573	618	663	709	754	799	845	890	216
13	502	555	608	662	715	768	821	874	928	981	1,034	235
14	572	634	696	757	819	881	942	1,004	1,066	1,127	1,189	254
15	647	718	789	860	931	1,001	1,072	1,143	1,214	1,285	1,356	273
16	728	808	889	969	1,050	1,130	1,211	1,292	1,372	1,453	1,533	293
17	813	904	995	1,086	1,177	1,268	1,359	1,450	1,541	1,632	1,723	313
18	903	1,005	1,107	1,209	1,311	1,413	1,515	1,617	1,719	1,821	1,923	333
19	998	1,112	1,226	1,339	1,453	1,567	1,680	1,794	1,908	2,021	2,135	354
20	1,099	1,225	1,351	1,477	1,603	1,728	1,854	1,980	2,106	2,232	2,358	376
21	1,204	1,343	1,482	1,621	1,760	1,898	2,037	2,176	2,315	2,454	2,593	398
22	1,315	1,467	1,619	1,772	1,924	2,077	2,229	2,381	2,534	2,686	2,838	421
23	1,430	1,597	1,763	1,930	2,096	2,263	2,429	2,596	2,763	2,929	3,096	445
24	1,551	1,732	1,913	2,095	2,276	2,457	2,639	2,820	3,001	3,183	3,364	469
25	1,676	1,873	2,070	2,267	2,463	2,660	2,857	3,054	3,250	3,447	3,644	495
26	1,807	2,020	2,233	2,445	2,658	2,871	3,084	3,297	3,509	3,722	3,935	521
27	1,943	2,172	2,402	2,631	2,861	3,090	3,320	3,549	3,779	4,008	4,238	549
28	2,083	2,330	2,577	2,824	3,070	3,317	3,564	3,811	4,058	4,305	4,551	578
29	2,229	2,494	2,758	3,023	3,288	3,553	3,818	4,082	4,347	4,612	4,877	608
30	2,380	2,663	2,946	3,230	3,513	3,796	4,080	4,363	4,646	4,930	5,213	639

[1] Add to and subtract from weight to obtain range interval.

MAPLE, RED (*Acer rubrum L.*)

Table 11.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 289.0249 - 29.4911D + 0.4045D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	260	286	311	337	363	389	415	441	467	493	519	150
9	285	318	351	384	416	449	482	515	547	580	613	163
10	317	358	398	439	479	519	560	600	641	681	722	179
11	356	405	454	502	551	600	649	698	747	796	845	195
12	401	459	517	575	634	692	750	808	867	925	983	212
13	452	520	589	657	725	794	862	931	999	1,067	1,136	229
14	510	589	668	748	827	906	986	1,065	1,144	1,223	1,303	247
15	574	665	756	847	938	1,029	1,120	1,211	1,302	1,393	1,484	265
16	645	749	852	956	1,059	1,163	1,266	1,370	1,473	1,577	1,681	283
17	722	839	956	1,073	1,190	1,307	1,424	1,541	1,658	1,774	1,891	302
18	806	937	1,068	1,199	1,330	1,461	1,592	1,723	1,855	1,986	2,117	320
19	896	1,042	1,188	1,334	1,480	1,626	1,772	1,918	2,065	2,211	2,357	338
20	993	1,155	1,317	1,478	1,640	1,802	1,964	2,126	2,287	2,449	2,611	356
21	1,096	1,275	1,453	1,631	1,810	1,988	2,167	2,345	2,523	2,702	2,880	375
22	1,206	1,402	1,597	1,793	1,989	2,185	2,381	2,576	2,772	2,968	3,164	393
23	1,322	1,536	1,750	1,964	2,178	2,392	2,606	2,820	3,034	3,248	3,462	412
24	1,445	1,678	1,911	2,144	2,377	2,610	2,843	3,075	3,308	3,541	3,774	431
25	1,574	1,826	2,079	2,332	2,585	2,838	3,090	3,343	3,596	3,849	4,102	450
26	1,709	1,983	2,256	2,530	2,803	3,076	3,350	3,623	3,897	4,170	4,444	470
27	1,851	2,146	2,441	2,736	3,031	3,326	3,620	3,915	4,210	4,505	4,800	489
28	2,000	2,317	2,634	2,951	3,268	3,585	3,902	4,220	4,537	4,854	5,171	509
29	2,155	2,495	2,835	3,175	3,515	3,856	4,196	4,536	4,876	5,216	5,556	530
30	2,316	2,680	3,044	3,408	3,772	4,136	4,500	4,864	5,228	5,592	5,956	551

[1] Add to and subtract from weight to obtain range interval.

MAPLE, SUGAR *(Acer saccharum Marsh.)*

Table 12.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 191.5229 - 12.9985D + 0.3917D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	288	313	338	363	388	413	438	463	488	513	538	177
9	328	360	391	423	455	487	518	550	582	613	645	196
10	374	414	453	492	531	570	609	649	688	727	766	217
11	427	475	522	569	617	664	712	759	806	854	901	238
12	486	543	599	656	712	768	825	881	938	994	1,050	259
13	552	618	684	750	816	883	949	1,015	1,081	1,147	1,214	280
14	623	700	777	854	930	1,007	1,084	1,161	1,237	1,314	1,391	302
15	701	789	877	966	1,054	1,142	1,230	1,318	1,406	1,494	1,582	323
16	785	886	986	1,086	1,186	1,287	1,387	1,487	1,588	1,688	1,788	345
17	876	989	1,102	1,215	1,329	1,442	1,555	1,668	1,781	1,895	2,008	367
18	972	1,099	1,226	1,353	1,480	1,607	1,734	1,861	1,988	2,115	2,242	388
19	1,075	1,217	1,358	1,500	1,641	1,782	1,924	2,065	2,207	2,348	2,489	410
20	1,185	1,341	1,498	1,655	1,811	1,968	2,125	2,281	2,438	2,595	2,751	432
21	1,300	1,473	1,646	1,818	1,991	2,164	2,337	2,509	2,682	2,855	3,028	454
22	1,422	1,611	1,801	1,991	2,180	2,370	2,559	2,749	2,939	3,128	3,318	475
23	1,550	1,757	1,964	2,171	2,379	2,586	2,793	3,000	3,208	3,415	3,622	497
24	1,684	1,910	2,135	2,361	2,587	2,812	3,038	3,263	3,489	3,715	3,940	519
25	1,825	2,069	2,314	2,559	2,804	3,049	3,294	3,538	3,783	4,028	4,273	541
26	1,971	2,236	2,501	2,766	3,031	3,295	3,560	3,825	4,090	4,355	4,619	563
27	2,125	2,410	2,696	2,981	3,267	3,552	3,838	4,123	4,409	4,695	4,980	586
28	2,284	2,591	2,898	3,205	3,512	3,819	4,127	4,434	4,741	5,048	5,355	608
29	2,450	2,779	3,108	3,438	3,767	4,097	4,426	4,756	5,085	5,414	5,744	630
30	2,621	2,974	3,327	3,679	4,032	4,384	4,737	5,089	5,442	5,794	6,147	653

[1] Add to and subtract from weight to obtain range interval.

OAK, CHESTNUT *(Quercus prinus L.)*

Table 13.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 183.3447 - 15.9959D + 0.4516D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	286	315	344	373	402	431	460	488	517	546	575	143
9	332	368	405	441	478	514	551	588	624	661	697	160
10	384	429	474	520	565	610	655	700	745	791	836	177
11	444	499	553	608	663	717	772	827	881	936	990	194
12	511	576	641	706	771	836	901	966	1,031	1,096	1,161	211
13	585	662	738	814	891	967	1,043	1,120	1,196	1,272	1,349	229
14	667	756	844	933	1,021	1,110	1,198	1,287	1,375	1,464	1,552	246
15	756	857	959	1,061	1,162	1,264	1,365	1,467	1,569	1,670	1,772	264
16	852	967	1,083	1,199	1,314	1,430	1,545	1,661	1,777	1,892	2,008	282
17	955	1,085	1,216	1,347	1,477	1,608	1,738	1,869	1,999	2,130	2,260	299
18	1,065	1,212	1,358	1,504	1,651	1,797	1,943	2,090	2,236	2,382	2,529	317
19	1,183	1,346	1,509	1,672	1,835	1,998	2,161	2,324	2,487	2,650	2,813	335
20	1,308	1,489	1,669	1,850	2,031	2,211	2,392	2,572	2,753	2,934	3,114	353
21	1,440	1,639	1,838	2,038	2,237	2,436	2,635	2,834	3,033	3,233	3,432	371
22	1,579	1,798	2,017	2,235	2,454	2,672	2,891	3,109	3,328	3,547	3,765	389
23	1,726	1,965	2,204	2,443	2,682	2,921	3,159	3,398	3,637	3,876	4,115	408
24	1,880	2,140	2,400	2,660	2,920	3,180	3,441	3,701	3,961	4,221	4,481	426
25	2,041	2,323	2,605	2,888	3,170	3,452	3,734	4,017	4,299	4,581	4,863	444
26	2,209	2,514	2,820	3,125	3,430	3,736	4,041	4,346	4,651	4,957	5,262	463
27	2,385	2,714	3,043	3,372	3,701	4,031	4,360	4,689	5,018	5,348	5,677	482
28	2,567	2,921	3,275	3,629	3,984	4,338	4,692	5,046	5,400	5,754	6,108	500
29	2,757	3,137	3,517	3,897	4,276	4,656	5,036	5,416	5,796	6,175	6,555	519
30	2,954	3,361	3,767	4,174	4,580	4,987	5,393	5,799	6,206	6,612	7,019	539

[1] Add to and subtract from weight to obtain range interval.

OAK, RED (*Quercus spp.*)

Table 14.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 169.0737 - 18.7765D + 0.4736D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	261	291	321	352	382	412	443	473	503	534	564	159
9	306	345	383	422	460	498	537	575	613	652	690	178
10	360	407	454	502	549	596	644	691	739	786	833	198
11	420	478	535	592	650	707	764	822	879	936	994	218
12	489	557	625	693	762	830	898	966	1,034	1,103	1,171	237
13	565	645	725	805	885	965	1,045	1,125	1,205	1,285	1,365	257
14	648	741	834	927	1,020	1,112	1,205	1,298	1,391	1,484	1,577	277
15	739	846	952	1,059	1,166	1,272	1,379	1,485	1,592	1,698	1,805	297
16	838	959	1,081	1,202	1,323	1,444	1,565	1,687	1,808	1,929	2,050	316
17	944	1,081	1,218	1,355	1,492	1,629	1,766	1,902	2,039	2,176	2,313	336
18	1,058	1,212	1,365	1,518	1,672	1,825	1,979	2,132	2,286	2,439	2,593	356
19	1,180	1,351	1,521	1,692	1,863	2,034	2,205	2,376	2,547	2,718	2,889	376
20	1,309	1,498	1,687	1,877	2,066	2,256	2,445	2,635	2,824	3,013	3,203	396
21	1,445	1,654	1,863	2,072	2,280	2,489	2,698	2,907	3,116	3,325	3,534	416
22	1,589	1,818	2,048	2,277	2,506	2,735	2,965	3,194	3,423	3,652	3,881	436
23	1,741	1,991	2,242	2,493	2,743	2,994	3,244	3,495	3,745	3,996	4,246	456
24	1,900	2,173	2,446	2,719	2,991	3,264	3,537	3,810	4,083	4,355	4,628	475
25	2,067	2,363	2,659	2,955	3,251	3,547	3,843	4,139	4,435	4,731	5,027	495
26	2,242	2,562	2,882	3,202	3,522	3,842	4,162	4,483	4,803	5,123	5,443	515
27	2,424	2,769	3,114	3,459	3,805	4,150	4,495	4,840	5,186	5,531	5,876	535
28	2,613	2,984	3,356	3,727	4,098	4,470	4,841	5,212	5,584	5,955	6,326	555
29	2,810	3,209	3,607	4,005	4,403	4,802	5,200	5,598	5,997	6,395	6,793	575
30	3,015	3,441	3,868	4,294	4,720	5,146	5,572	5,999	6,425	6,851	7,277	595

[1] Add to and subtract from weight to obtain range interval.

OAK, WHITE (*Quercus spp.*)

Table 15.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 224.7721 - 24.9150D + 0.4677D^2L$]

Scaling diameter	Log length (feet)											Half-width of 95% confidence interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	264	294	324	354	384	414	444	474	504	534	564	170
9	303	341	379	417	455	493	530	568	606	644	682	187
10	349	396	443	490	536	583	630	677	723	770	817	206
11	403	460	516	573	629	686	743	799	856	912	969	225
12	464	531	599	666	734	801	868	936	1,003	1,070	1,138	245
13	533	612	691	770	849	928	1,007	1,086	1,165	1,244	1,323	265
14	609	701	792	884	976	1,067	1,159	1,251	1,342	1,434	1,526	286
15	692	798	903	1,008	1,113	1,219	1,324	1,429	1,534	1,640	1,745	306
16	784	903	1,023	1,143	1,262	1,382	1,502	1,622	1,741	1,861	1,981	327
17	882	1,017	1,152	1,288	1,423	1,558	1,693	1,828	1,963	2,099	2,234	348
18	988	1,140	1,291	1,443	1,594	1,746	1,897	2,049	2,200	2,352	2,504	368
19	1,102	1,270	1,439	1,608	1,777	1,946	2,115	2,284	2,452	2,621	2,790	389
20	1,223	1,410	1,597	1,784	1,971	2,158	2,345	2,532	2,719	2,906	3,094	410
21	1,351	1,557	1,764	1,970	2,176	2,382	2,589	2,795	3,001	3,208	3,414	431
22	1,487	1,714	1,940	2,166	2,393	2,619	2,845	3,072	3,298	3,524	3,751	452
23	1,631	1,878	2,125	2,373	2,620	2,868	3,115	3,363	3,610	3,857	4,105	473
24	1,782	2,051	2,320	2,590	2,859	3,129	3,398	3,667	3,937	4,206	4,476	494
25	1,940	2,232	2,525	2,817	3,109	3,402	3,694	3,986	4,279	4,571	4,863	516
26	2,106	2,422	2,738	3,054	3,371	3,687	4,003	4,319	4,635	4,951	5,268	537
27	2,279	2,620	2,961	3,302	3,643	3,984	4,325	4,666	5,007	5,348	5,689	559
28	2,460	2,827	3,194	3,560	3,927	4,294	4,660	5,027	5,394	5,760	6,127	581
29	2,649	3,042	3,435	3,829	4,222	4,615	5,009	5,402	5,795	6,189	6,582	603
30	2,844	3,265	3,686	4,107	4,528	4,949	5,370	5,791	6,212	6,633	7,054	625

[1] Add to and subtract from weight to obtain range interval.

YELLOW-POPLAR *(Liriodendron tulipifera L.)*

Table 16.—Estimated weight of logs with bark by length and diameter inside bark, small end

[Table based on $W = 144.0939 - 11.1559D + 0.3553D^2L$]

Scaling diameter	Log length (feet)											Half-width confidence of 95% interval[1]
	8	9	10	11	12	13	14	15	16	17	18	
In.	*Sawlog weight, lbs.*											*Lbs.*
8	236	259	282	304	327	350	373	395	418	441	464	131
9	273	302	331	360	389	417	446	475	504	532	561	147
10	316	352	387	423	458	494	529	565	601	636	672	163
11	365	408	451	494	537	580	623	666	709	752	795	179
12	419	470	521	573	624	675	726	777	828	880	931	195
13	479	539	599	659	719	779	839	899	959	1,019	1,079	211
14	545	614	684	753	823	893	962	1,032	1,102	1,171	1,241	228
15	616	696	776	856	936	1,016	1,096	1,175	1,255	1,335	1,415	244
16	693	784	875	966	1,057	1,148	1,239	1,330	1,421	1,511	1,602	261
17	775	878	981	1,084	1,186	1,289	1,392	1,494	1,597	1,700	1,802	277
18	864	979	1,094	1,209	1,324	1,439	1,555	1,670	1,785	1,900	2,015	294
19	958	1,086	1,214	1,343	1,471	1,599	1,727	1,856	1,984	2,112	2,241	310
20	1,058	1,200	1,342	1,484	1,626	1,768	1,910	2,052	2,195	2,337	2,479	327
21	1,163	1,320	1,476	1,633	1,790	1,946	2,103	2,260	2,417	2,573	2,730	343
22	1,274	1,446	1,618	1,790	1,962	2,134	2,306	2,478	2,650	2,822	2,994	360
23	1,391	1,579	1,767	1,955	2,143	2,331	2,519	2,707	2,895	3,082	3,270	376
24	1,513	1,718	1,923	2,127	2,332	2,537	2,741	2,946	3,151	3,355	3,560	393
25	1,641	1,863	2,085	2,308	2,530	2,752	2,974	3,196	3,418	3,640	3,862	409
26	1,775	2,015	2,256	2,496	2,736	2,976	3,216	3,457	3,697	3,937	4,177	426
27	1,915	2,174	2,433	2,692	2,951	3,210	3,469	3,728	3,987	4,246	4,505	443
28	2,060	2,338	2,617	2,896	3,174	3,453	3,731	4,010	4,288	4,567	4,846	460
29	2,211	2,510	2,808	3,107	3,406	3,705	4,004	4,303	4,601	4,900	5,199	477
30	2,367	2,687	3,007	3,327	3,646	3,966	4,286	4,060	4,926	5,245	5,565	493

[1] Add to and subtract from weight to obtain range interval.

RELIABILITY OF TABLES

To check the reliability of the tables, we made a test at three mills not sampled during the data gathering phase. Two mills were in the original sampling region (fig. 1), and the third was in north-central New York.

The test had two objectives: the first was to see if 95 percent of the logs weighed would fall within the range of weight values predicted in the tables (table 17, appendix). At the three mills, we weighed 3,468 logs; 95.53 percent of the logs fell within the limits given in the tables.

The second objective was to check the reliability of a table predicting log weight in a given situation. (See appendix for test procedure.) At the test site in east-central West Virginia, seven tables were checked—white ash, basswood, beech, hickory, sugar maple, red oak, and yellow-poplar. Beech and yellow-poplar were not significantly different at the 5-percent level from the tables as published (appendix, table 18).

In northeastern West Virginia, seven species—beech, black cherry, red maple, sugar maple, chestnut oak, red oak, and yellow-poplar—were checked. Three species—beech, red maple, and sugar maple—were not significantly different from the tables as published (appendix, table 19).

At the test site in north-central New York, three tables were checked—beech, birch, and sugar maple—and all were found to differ significantly from the tables (appendix, table 20).

The results were not unexpected. Because of all the factors that affect weight, it would not be unusual to have to adjust weight tables to fit actual conditions in a given situation.

DISCUSSION

Two logs of the same size and species will often differ greatly in weight. This was revealed by the study and is shown by the prediction interval. It was this variation that we wanted our confidence intervals to reflect; therefore the tabular values are based on mill-run logs, and no compensation was made for any factor that could affect log weight.

The tables give the weight one might expect for a log of a given size and species. Also, by use of the value in the half-width column, the range in pounds that will include 95 logs out of 100 can be computed.

If the tables are to be used to predict the weight of logs in a situation other than that under which they were constructed, then the tables should be tested for that particular situation; for instance, logs from a given site. The test we used in making reliability checks on these tables is an acceptable method (appendix).

As our check revealed, it may be necessary to use an adjustment factor to bring predicted weight in line with observed weights. Studies are now under way to design methods of computing an adjustment factor so that a table, or results obtained from tables, may be adjusted to the accuracy needed for a particular procedure such as weight scaling.

As of now, we will only suggest that the predicted weight (preferably group weight) be adjusted by the percent mean difference obtained as a result of conducting the reliability check as described in the appendix.

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APPENDIX

Table 17.—Percent of logs tested that fell within 95 percent prediction interval

Location	Species	Total no. of logs	% within prediction interval
East-central West Virginia (X_1, Fig. 1)	Red maple	15	100.00
	Sugar maple	105	96.19
	Birch	96	95.83
	Hickory	80	96.25
	Beech	130	93.08
	White ash	137	97.08
	Yellow-poplar	414	91.06
	Red Oak	140	97.14
	Basswood	214	96.26
	ALL	1,331	94.51
Northeast West Virginia (X_2, Fig. 1)	Red maple	117	100.00
	Sugar maple	98	97.96
	Beech	61	95.08
	Yellow-poplar	252	94.44
	Black cherry	113	92.92
	Chestnut oak	93	93.55
	Red oak	171	96.49
	Basswood	48	95.83
	ALL	953	95.59
North-central New York	Birch	331	96.07
	Sugar maple	600	97.17
	Beech	253	95.65
	ALL	1,184	96.54
All locations	Red maple	132	100.00
	Sugar maple	803	97.14
	Birch	427	96.02
	Hickory	80	96.25
	Beech	444	94.82
	White ash	137	97.08
	Yellow-poplar	666	92.34
	Black cherry	113	92.92
	Chestnut oak	93	93.55
	Red oak	311	96.78
	Basswood	262	96.18
	ALL	3,468	95.53

Reliability Test of Tables

The weight tables must be checked to determine their reliability when applied to logs weighed in specific situations and in other localities and seasons.

The procedure used for evaluating weight table reliability is outlined below. This method first compares the difference in weight between the actual log in the check sample and the estimated weight shown for a similar log in the table. The difference between the actual and estimated weight is noted for each, and the differences are totaled and averaged to find the percent mean difference.

At this point, the user might be tempted to adjust his tables by the percent mean difference to get a more accurate measure of the grouped weight of logs sampled in his area. However, he has no assurance that the logs in his first sample represent the weight variation found for the whole stand or locality. Therefore, he must use the procedures outlined below to delineate this variation in terms of confidence limits. When he has done this, he can then determine the number of *additional* check samples needed to give him the measure of log weight variation and reliability that he needs to make for proper table adjustment.

In the outline below, steps 3b through 7, show how to calculate the number of logs needed to make one confident that the calculated percent mean difference is reasonably close to the true percent mean difference (the percent difference between actual and predicted weight of all the logs whose weights are to be predicted if the difference was calculated based on knowing the actual weight and measurement of each log). Steps 8 and 9 are instructions on when to adjust the table if all steps are followed.

For the purpose of the test conducted for this paper, we used a $\pm$ 2 percent interval or less at the 95 percent confidence level. This means we are 95 percent sure that the true percent mean difference lies somewhere within the range of $\pm$ 2 percent or less (based on table weight) of the percent mean difference found for the logs sampled. For example: if we found the percent mean difference for the logs sampled to be 4.5 percent, we could be confident that 95 percent of the time the true percent mean difference would be somewhere in the range of 2.5 percent to 6.5 percent.

The person using this test has to make one decision before he calculates the number of logs needed to give some confidence to the percent mean difference for the logs he samples. The decision is the degree of accuracy he desires to place in the test. In step 4, this is called *desired half-width* —the half-width being the value (percent in this case) one adds to and subtracts from the calculated mean difference to obtain the range in which the true mean difference lies.

Test Procedure

(Conduct for Each Table)

1. Weigh and measure (scaling diameter and length) a sample of $n = 60$ logs.
2. Find percent difference (d_i) between the actual weight (AW) and predicted weight (PW) for each log:

$$d_i = [(PW - AW)/AW] \times 100$$

3. Calculate the following for the sample of 60 logs:
   a. Percent mean difference ($\overline{D}$) for sample

$$\overline{D} = \sum_{i=1}^{n} d_i/n \text{ or } (d_1 + d_2 + d_3 + \text{----- } d_n)/n$$

   b. Standard deviation (S) for sample

$$S = \sqrt{[\Sigma d_i^2 - (\Sigma d_i)^2/n]/(n-1)}$$

   c. The half width of 95 percent confidence interval (CW) for the sample

$$CW = t_{0.05,n}\ (S/\sqrt{n})$$

$$\text{where } t_{0.05,n} = 2.00 \text{ (for } n = 60 \text{ logs)}$$

4. If (CW) is smaller than the *desired* half-width (W) of the confidence interval, the sample size is adequate and no more logs need be measured. (Go to step 8 if $CW \leq W$).
5. If (CW) is larger than the *desired* half-width (W) of the confidence interval, take another sample such that the total logs measured and weighed are equal to or larger than (N).

$$N = 2.00\ S/W$$

   Note: If $W = 2.00$, then N should be one more than the rounded value of S.

6. Weigh and measure the additional logs needed to give desired W. Additional logs needed = Total logs required (N) — logs originally weighed (n or 60).
7. Calculate new percent mean difference ($\overline{D}$) based on the whole sample:

$$\overline{D} = \sum_{i=1}^{N} d_i/N \text{ or } (d_1 + d_2 + d_3 + \text{----- } d_n)/N$$

[It is shown in Cochran (1953:59), that:

Probability (Pr) $(| \bar{D} - \Delta | \geq W) \leq 0.05$

where Δ is the true percent difference. The confidence statement can also be written as:

$\Pr (\bar{D} - W \leq \Delta \leq \bar{D} + W) \geq 0.95$

In other words, $\bar{D} \pm W$ is the 95 percent confidence interval for the bias in the tables.

The confidence statements are based on the assumption that the percent differences are normally distributed. Also, we have taken the view that the table values are fixed instead of random variables.][3]

8. If $\bar{D}$ is equal to or less than W, the table weights are suitable to use as published for the situation in which they were tested.

9. If $\bar{D}$ is greater than W, then some adjustment is needed if table weights are put to use in the situation for which tables are tested.

Adjustment of Tables

For now, if the test shows some adjustment of table is needed, you should use $\bar{D}$ as value of adjustment factor. Individual log weight in the table should not be adjusted, but the adjustment should be applied to total predicted weight obtained from the sum of the individual log weights. This total weight should be adjusted by the factor $1 - \bar{D}/100$.

Example: The red oak table is tested in a given situation where $\bar{D} = +4.5$ percent with a 2 percent half-width of the confidence interval (W). Since $\bar{D} > W$, some adjustment is necessary. The weight of each log in the group is predicted and the values are totaled. Suppose the total predicted weight was 45,000 pounds. This weight should be multiplied by the factor $(1 - \bar{D}/100)$. In this case, $(1 - (+4.5)/100)$ gives $45{,}000 \times .955$ which equals 42,975 pounds adjusted predicted weight.

So for future samples drawn from the same population, the user should adjust his estimated tabular red oak values by 4.5 percent. Since the check sample shows the table value to overestimate, the adjustment would be to reduce estimated tabular values.

[3] Cochran, W. G. Sampling techniques. 322 pp. John Wiley and Sons, N.Y. 1953.

Table 18.—Check of Appalachian sawlog predicted weights in east-central West Virginia

Species	No. logs in sample	Percent mean difference per log	Half-width of 95% confidence interval
White ash	137	[1]—7.09	1.74
Basswood	214	2.29	1.81
Beech	130	—1.97	1.98
Hickory	80	—3.14	1.97
Sugar maple	105	—3.45	2.00
Red oak	140	—2.09	1.77
Yellow-poplar	417	.79	1.41

[1] (—) Minus indicates estimated weight less than actual weight.

Table 19.—Check of Appalachian sawlog predicted weights in northeastern West Virginia

Species	No logs in sample	Percent mean difference per log	Half-width of 95% confidence interval
Beech	61	2.27	[1]2.43
Black cherry	112	[2]—3.13	2.05
Red maple	117	.76	2.03
Sugar maple	99	—.87	2.07
Chestnut oak	93	—3.76	2.01
Red oak	171	—2.70	1.55
Yellow-poplar	252	6.83	1.87

[1] Required number of logs not available at time of test to reduce interval to 2 percent.
[2] (—) Minus indicates estimated weight less than actual weight.

Table 20.—Check of Appalachian sawlog predicted weights in north-central New York

Species	No logs in sample	Percent mean difference per log	Half-width of 95% confidence interval
Beech	260	12.33	2.05
Birch (yellow)	331	9.36	1.39
Sugar maple	600	1.52	1.06

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