(iii) (a) If n is even, n = 2k, compute

$$b = \sum_{i=1}^{k} a_{n-i+1} (y_{n-i+1} - y_i),$$

where the values of a_{n-i+1} are given in Table 5.

(b) If n is odd, n=2k+1, the computation is just as in (iii) (a), since $a_{k+1}=0$ when n=2k+1. Thus one finds

$$b = a_n(y_n - y_1) + \dots + a_{k+2}(y_{k+2} - y_k),$$

where the value of y_{k+1} , the sample median, does not enter the computation of b.

- (iv) Compute $W = b^2/S^2$.
- (v) 1, 2, 5, 10, 50, 90, 95, 98 and 99 % points of the distribution of W are given in Table 6. Small values of W are significant, i.e. indicate non-normality.
- (vi) A more precise significance level may be associated with an observed W value by using the approximation detailed in Shapiro & Wilk (1965a).

Table 5. Coefficients $\{a_{n-i+1}\}\$ for the W test for normality, for $n=2(1)\,50$.

					J	()				
i^n	2	3	4	5	6	7	8	9	10	
1	0.7071	0.7071	0.6872	0.6646	0.6431	0.6233	0.6052	0.5888	0.5739	
2		.0000	.1677	$\cdot 2413$	$\cdot 2806$.3031	·3164	$\cdot 3244$	$\cdot 3291$	
3	_			.0000	$\cdot 0875$	$\cdot 1401$	$\cdot 1743$	$\cdot 1976$	$\cdot 2141$	
4				-		.0000	$\cdot 0561$	$\cdot 0947$	$\cdot 1224$	
5		_					_	.0000	$\cdot 0399$	
i^n	11	12	13	14	15	16	17	18	19	20
1	0.5601	0.5475	0.5359	0.5251	0.5150	0.5056	0.4968	0.4886	0.4808	0.4734
2	$\cdot 3315$	$\cdot 3325$	$\cdot 3325$.3318	·3306	$\cdot 3290$	$\cdot 3273$	$\cdot 3253$	$\cdot 3232$	$\cdot 3211$
3	$\cdot 2260$	$\cdot 2347$	$\cdot 2412$	$\cdot 2460$	$\cdot 2495$	$\cdot 2521$	$\cdot 2540$	$\cdot 2553$	$\cdot 2561$	$\cdot 2565$
4	$\cdot 1429$	-1586	-1707	$\cdot 1802$	·1878	$\cdot 1939$	·1988	-2027	-2059	$\cdot 2085$
5	$\cdot 0695$	$\cdot 0922$	·1099	·1240	$\cdot 1353$	$\cdot 1447$	$\cdot 1524$	$\cdot 1587$	·1641	·1686
6	0.0000	0.0303	0.0539	0.0727	0.0880	0.1005	0.1109	0.1197	0.1271	0.1334
7			$\cdot 0000$	$\cdot 0240$	$\cdot 0433$	$\cdot 0593$	$\cdot 0725$	$\cdot 0837$	$\cdot 0932$	·1013
8				-	$\cdot 0000$	$\cdot 0196$	$\cdot 0359$	$\cdot 0496$	$\cdot 0612$	$\cdot 0711$
9							$\cdot 0000$	$\cdot 0163$	$\cdot 0303$	$\cdot 0422$
10						-	-		.0000	.0140
10 n	21	22	23	24	25	26	27	28	·0000 29	·0140 30
		22 0·4590		24 0·4493		26 0⋅4407		28 0·4328		
i^n	21		23		25		27		29	30
i i 1	21 0·4643	0.4590	23 0·4542	0.4493	25 0·4450	0.4407	27 0·4366	0.4328	29 0·4291	30 0·4254
i i i i i i i i	21 0·4643 ·3185	$0.4590 \\ \cdot 3156$	23 0·4542 ·3126	$0.4493 \\ \cdot 3098$	25 0·4450 ·3069	$0.4407 \\ \cdot 3043$	27 0·4366 ·3018	$0.4328 \\ \cdot 2992$	29 0·4291 ·2968	30 0·4254 •2944
i n 1 2 3	21 0·4643 ·3185 ·2578	0.4590 $\cdot 3156$ $\cdot 2571$	23 0·4542 ·3126 ·2563	0.4493 $\cdot 3098$ $\cdot 2554$	25 0·4450 ·3069 ·2543	$0.4407 \\ \cdot 3043 \\ \cdot 2533$	27 0·4366 ·3018 ·2522	$0.4328 \\ \cdot 2992 \\ \cdot 2510$	29 0·4291 ·2968 ·2499	30 0·4254 •2944 •2487
i n 1 2 3 4	21 0·4643 ·3185 ·2578 ·2119	0.4590 $\cdot 3156$ $\cdot 2571$ $\cdot 2131$	23 0·4542 ·3126 ·2563 ·2139	0.4493 $\cdot 3098$ $\cdot 2554$ $\cdot 2145$	25 0·4450 ·3069 ·2543 ·2148	0.4407 $\cdot 3043$ $\cdot 2533$ $\cdot 2151$	27 0·4366 ·3018 ·2522 ·2152	0.4328 $\cdot 2992$ $\cdot 2510$ $\cdot 2151$	29 0·4291 ·2968 ·2499 ·2150	30 0·4254 •2944 •2487 •2148
i 1 2 3 4 5	21 0·4643 ·3185 ·2578 ·2119 ·1736	0.4590 $\cdot 3156$ $\cdot 2571$ $\cdot 2131$ $\cdot 1764$	23 0·4542 ·3126 ·2563 ·2139 ·1787	0.4493 $\cdot 3098$ $\cdot 2554$ $\cdot 2145$ $\cdot 1807$	25 0·4450 ·3069 ·2543 ·2148 ·1822	0.4407 $\cdot 3043$ $\cdot 2533$ $\cdot 2151$ $\cdot 1836$	27 0·4366 ·3018 ·2522 ·2152 ·1848	0.4328 $.2992$ $.2510$ $.2151$ $.1857$	29 0·4291 ·2968 ·2499 ·2150 ·1864	30 0·4254 ·2944 ·2487 ·2148 ·1870
i 1 2 3 4 5 6	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399	0.4590 $.3156$ $.2571$ $.2131$ $.1764$ 0.1443	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584	0.4328 $.2992$ $.2510$ $.2151$ $.1857$ 0.1601	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630
n 1 2 3 4 5 6 7	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399 ·1092	0·4590 ·3156 ·2571 ·2131 ·1764 0·1443 ·1150	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480 ·1201	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512 ·1245	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539 ·1283	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563 ·1316	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584 ·1346	0.4328 $\cdot 2992$ $\cdot 2510$ $\cdot 2151$ $\cdot 1857$ 0.1601 $\cdot 1372$	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616 ·1395	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630 ·1415
n 1 2 3 4 5 6 7 8	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399 ·1092 ·0804	0·4590 ·3156 ·2571 ·2131 ·1764 0·1443 ·1150 ·0878	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480 ·1201 ·0941	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512 ·1245 ·0997	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539 ·1283 ·1046	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563 ·1316 ·1089	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584 ·1346 ·1128	0·4328 ·2992 ·2510 ·2151 ·1857 0·1601 ·1372 ·1162	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616 ·1395 ·1192	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630 ·1415 ·1219
n 1 2 3 4 5 6 7 8 9 10 11	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399 ·1092 ·0804 ·0530	0·4590 ·3156 ·2571 ·2131 ·1764 0·1443 ·1150 ·0878 ·0618	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480 ·1201 ·0941 ·0696	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512 ·1245 ·0997 ·0764 ·0539 0·0321	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539 ·1283 ·1046 ·0823	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563 ·1316 ·1089 ·0876	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584 ·1346 ·1128 ·0923 ·0728 0·0540	0·4328 ·2992 ·2510 ·2151 ·1857 0·1601 ·1372 ·1162 ·0965	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616 ·1395 ·1192 ·1002	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630 ·1415 ·1219 ·1036
n 1 2 3 4 5 6 7 8 9 10 11 12	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399 ·1092 ·0804 ·0530 ·0263	0·4590 ·3156 ·2571 ·2131 ·1764 0·1443 ·1150 ·0878 ·0618 ·0368	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480 ·1201 ·0941 ·0696 ·0459	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512 ·1245 ·0997 ·0764 ·0539	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539 ·1283 ·1046 ·0823 ·0610	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563 ·1316 ·1089 ·0876 ·0672	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584 ·1346 ·1128 ·0923 ·0728	0·4328 ·2992 ·2510 ·2151 ·1857 0·1601 ·1372 ·1162 ·0965 ·0778 0·0598 ·0424	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616 ·1395 ·1192 ·1002 ·0822	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630 ·1415 ·1219 ·1036 ·0862
n 1 2 3 4 5 6 7 8 9 10 11 12 13	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399 ·1092 ·0804 ·0530 ·0263 0·0000	0·4590 ·3156 ·2571 ·2131 ·1764 0·1443 ·1150 ·0878 ·0618 ·0368	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480 ·1201 ·0941 ·0696 ·0459 0·0228	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512 ·1245 ·0997 ·0764 ·0539 0·0321	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539 ·1283 ·1046 ·0823 ·0610 0·0403	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563 ·1316 ·1089 ·0876 ·0672 0·0476	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584 ·1346 ·1128 ·0923 ·0728 0·0540 ·0358 ·0178	0·4328 ·2992 ·2510 ·2151 ·1857 0·1601 ·1372 ·1162 ·0965 ·0778 0·0598	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616 ·1395 ·1192 ·1002 ·0822 0·0650	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630 ·1415 ·1219 ·1036 ·0862 0·0697
n 1 2 3 4 5 6 7 8 9 10 11 12	21 0·4643 ·3185 ·2578 ·2119 ·1736 0·1399 ·1092 ·0804 ·0530 ·0263 0·0000	0·4590 ·3156 ·2571 ·2131 ·1764 0·1443 ·1150 ·0878 ·0618 ·0368	23 0·4542 ·3126 ·2563 ·2139 ·1787 0·1480 ·1201 ·0941 ·0696 ·0459 0·0228	0·4493 ·3098 ·2554 ·2145 ·1807 0·1512 ·1245 ·0997 ·0764 ·0539 0·0321	25 0·4450 ·3069 ·2543 ·2148 ·1822 0·1539 ·1283 ·1046 ·0823 ·0610 0·0403 ·0200	0·4407 ·3043 ·2533 ·2151 ·1836 0·1563 ·1316 ·1089 ·0876 ·0672 0·0476 ·0284	27 0·4366 ·3018 ·2522 ·2152 ·1848 0·1584 ·1346 ·1128 ·0923 ·0728 0·0540 ·0358	0·4328 ·2992 ·2510 ·2151 ·1857 0·1601 ·1372 ·1162 ·0965 ·0778 0·0598 ·0424	29 0·4291 ·2968 ·2499 ·2150 ·1864 0·1616 ·1395 ·1192 ·1002 ·0822 0·0650 ·0483	30 0·4254 ·2944 ·2487 ·2148 ·1870 0·1630 ·1415 ·1219 ·1036 ·0862 0·0697 ·0537

Table 6. Percentage points of the W test* for n = 3(1)50

Level n0.01 0.02 0.050.10 0.50 0.90 0.95 0.98 0.99 0.753 3 0.7560.7670.7890.9590.9980.9991.000 1.000 4 .687 .707 $\cdot 748$.792 $\cdot 935$.987.992.996 .9975 .927 .979 .686 $\cdot 715$ $\cdot 762$ ·806 .986.991 .9930.7880.8260.9270.9740.981 6 0.7130.7430.9860.989 7 .730.760.803 .838 .928 .972.979.985.988 8 .749.778.818 .851 .932.972 .978 .984 .987 9 $\cdot 764$ $\cdot 829$.859 .935.972 .978.986 $\cdot 791$.98410 $\cdot 781$ $\cdot 806$ $\cdot 842$ $\cdot 869$.938 $\cdot 972$.978.983.98611 0.7920.817 0.8500.8760.940 0.9730.979 0.9840.98612 .805 .828 .859 .883 .943.973.979 .984 .986 13 ·814 $\cdot 837$ ·866 .889 .945.974 .979.984 .98614 $\cdot 825$ $\cdot 846$ $\cdot 874$ $\cdot 895$ $\cdot 947$ $\cdot 975$.980.984.98615 .980 $\cdot 835$.881 .901.950.975.984 .987 $\cdot 855$ 16 0.8440.863 0.887 0.906 0.9520.976 0.981 0.9850.987 17 .851 .869 .892 ·910 .954.977.981.985 .987 18 .897.956.978.982 $\cdot 858$ ·874 .914 .986.988 19 .901 .978 .982 .863.917 .957 .986.988 .87920 .905 .868 .884 .920 .959.979.983.986.988 21 0.8730.8880.9080.9230.9600.9800.9830.9870.98922 .892.911.926.961.980.984 $\cdot 878$.987 .98923 ·881 ·895 .914 .928 .962 .981 .984 .987 .989 24 ·884 898 ·916 .930 .963 .981 .984 .987 .989 25 .888 ·901 .918.931.964 .981 .985.988.98926 0.8910.904 0.9200.933 0.9650.9820.9850.988 0.98927 .894 .906.923.935.965.982.985.988 .990 28 ·896 .908.924.936 .966 $\cdot 982$.985.988 .99029 -926-898 -910-937-966-982-985-988 -990 **30** .900 $\cdot 912$.927.939.967 .983 .985.988.900 0.92931 0.9020.9140.9400.967 0.9830.9860.988 0.99032 .904 .915 .930 .941.968 .983 .986 .988 .990 33 .906 .931.968 .983.989 .917 $\cdot 942$.986.990 34 .908 .919.933.943·969 .983.986.989.990 35 .910 .920 $\cdot 934$ $\cdot 944$.969.984 $\cdot 986$.989.99036 0.9120.9220.9350.9450.9700.9840.9860.9890.990·914 37 $\cdot 924$.936.970 .984 .946.987.989 .990 38 .938 .984 .916 .925.947.971.987.989.990 39 $\cdot 917$ $\cdot 927$.939.948.971.984 .987.989.991 40 .985.919 $\cdot 928$ ·940 .949 $\cdot 972$.987.989.99141 0.920 0.9290.9500.9720.9850.9870.9410.9890.99142 .922.930 .985 .942.951.972.987.989.991 .93243 .923.943 .951 .973.985 .987.990 .99144 .924.933.944 .952.973.985.987.990 .991 45 $\cdot 926$.934.945.953.973.985 $\cdot 988$.990.99146 0.9270.9350.9450.9530.9740.985 0.988 0.990 0.991 .936.98547 .928.946.954 .974.988.990 .99148 .929.937.947.954.974.985.988.990 .991 49 $\cdot 929$.937 $\cdot 947$ $\cdot 974$ $\cdot 985$ $\cdot 955$.988 $\cdot 990$.991**50** .930 .938 $\cdot 947$ $\cdot 974$ $\cdot 985$.991 $\cdot 955$.988.990

^{*} Based on fitted Johnson (1949) S_B approximation, see Shapiro & Wilk (1965a) for details.