[] Dendrochronology Program Library Run FAGR Program COF 08:32 Tue 14 Nov 2017 Page 1

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[] P R O G R A M C O F E C H A Version 6.06P 30270

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QUALITY CONTROL AND DATING CHECK OF TREE-RING MEASUREMENTS

Title of run: FAGR\_NB\_CORR1-50

File of DATED series: FAGR\_NB\_CORR1

CONTENTS:

Part 1: Title page, options selected, summary, absent rings by series

Part 2: Histogram of time spans

Part 3: Master series with sample depth and absent rings by year

Part 4: Bar plot of Master Dating Series

Part 5: Correlation by segment of each series with Master

Part 6: Potential problems: low correlation, divergent year-to-year changes, absent rings, outliers

Part 7: Descriptive statistics

RUN CONTROL OPTIONS SELECTED VALUE

1 Cubic smoothing spline 50% wavelength cutoff for filtering

32 years

2 Segments examined are 50 years lagged successively by 25 years

3 Autoregressive model applied A Residuals are used in master dating series and testing

4 Series transformed to logarithms Y Each series log-transformed for master dating series and testing

5 CORRELATION is Pearson (parametric, quantitative)

Critical correlation, 99% confidence level .3281

6 Master dating series saved N

7 Ring measurements listed Y

8 Parts printed 1234567

9 Absent rings are omitted from master series and segment correlations (Y)

Time span of Master dating series is 1876 to 2016 141 years

Continuous time span is 1876 to 2016 141 years

Portion with two or more series is 1880 to 2016 137 years

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*C\* Number of dated series 35 \*C\*

\*O\* Master series 1876 2016 141 yrs \*O\*

\*F\* Total rings in all series 3426 \*F\*

\*E\* Total dated rings checked 3422 \*E\*

\*C\* Series intercorrelation .570 \*C\*

\*H\* Average mean sensitivity .211 \*H\*

\*A\* Segments, possible problems 4 \*A\*

\*\*\* Mean length of series 97.9 \*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

ABSENT RINGS listed by SERIES: (See Master Dating Series for absent rings listed by year)

No ring measurements of zero value

1900 -.245 9 1950 -2.136 30 2000 -.490 35

1901 .650 11 1951 .519 30 2001 -.312 35

1902 .530 11 1952 -.373 30 2002 -.237 35

1903 .300 11 1953 -.765 30 2003 -.570 35

1904 -.951 11 1954 .216 30 2004 .984 35

1905 -.407 11 1955 .886 30 2005 .294 35

1906 .642 13 1956 .122 30 2006 .027 35

1907 -.726 15 1957 .939 30 2007 .946 35

1908 -1.286 16 1958 .383 30 2008 1.304 35

1909 -1.855 16 1959 -.111 30 2009 1.695 35

1910 -.069 16 1960 .244 30 2010 .098 35

1911 -.846 16 1961 1.282 30 2011 -.827 35

1912 -.093 18 1962 .906 30 2012 .233 35

1913 .355 18 1963 -1.111 30 2013 -.884 35

1914 -.125 18 1964 1.158 32 2014 -.319 35

1915 .970 19 1965 .584 32 2015 .990 35

1916 1.435 19 1966 -.467 32 2016 -1.276 35

1917 1.333 19 1967 -.214 32

1918 1.261 20 1968 .276 34

1919 -.866 20 1969 -.023 35

1920 .323 20 1970 .080 35

1921 .797 21 1971 .186 35

1922 -.030 22 1972 .944 35

1923 -.952 22 1973 .806 35

1924 -1.699 22 1974 .142 35

1925 -.584 22 1975 -.009 35

1876 .264 1 1926 .969 23 1976 -.809 35

1877 2.379 1 1927 1.238 23 1977 -.605 35

1878 2.522 1 1928 .262 23 1978 -4.267 35

1879 .726 1 1929 -.244 23 1979 -2.099 35

1880 .895 2 1930 -.589 23 1980 -.516 35

1881 .879 3 1931 -.215 23 1981 .779 35

1882 .117 3 1932 1.157 24 1982 .939 35

1883 -.335 3 1933 -.317 24 1983 .777 35

1884 -1.811 3 1934 -1.366 24 1984 .667 35

1885 -.559 3 1935 -.360 24 1985 .039 35

1886 -.948 3 1936 -.614 25 1986 .606 35

1887 -1.771 3 1937 -.298 25 1987 .943 35

1888 -1.356 4 1938 -.025 26 1988 .405 35

1889 .079 4 1939 .680 26 1989 .377 35

1890 -1.280 7 1940 .208 26 1990 -1.095 35

1891 -.039 8 1941 -.708 26 1991 .264 35

1892 1.466 8 1942 .856 26 1992 .434 35

1893 -.466 8 1943 .250 27 1993 1.130 35

1894 .535 8 1944 .908 27 1994 .746 35

1895 .017 8 1945 .159 27 1995 .188 35

1896 .652 8 1946 .504 28 1996 -2.583 35

1897 .752 8 1947 1.220 29 1997 -2.293 35

1898 .824 9 1948 -1.094 30 1998 -1.098 35

1899 .089 9 1949 -2.630 30 1999 -.492 35

PART 5: CORRELATION OF SERIES BY SEGMENTS: FAGR\_NB\_CORR1-50 08:32 Tue 14 Nov 2017 Page 5

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Correlations of 50-year dated segments, lagged 25 years

Flags: A = correlation under .3281 but highest as dated; B = correlation higher at other than dated position

Seq Series Time\_span 1875 1900 1925 1950 1975

1924 1949 1974 1999 2024

--- -------- --------- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----

1 1A 1891 2016 .67 .70 .66 .57 .53

2 1B 1890 2016 .52 .54 .55 .39 .42

3 2A 1890 2016 .44 .50 .46 .54 .61

4 2B 1888 2016 .43 .44 .47 .55 .51

5 3A 1881 2016 .58 .55 .50 .45 .49

6 3B 1876 2016 .44 .48 .40 .38 .37

7 4A 1880 2016 .42 .54 .58 .44 .45

8 4B 1901 2016 .63 .54 .40 .42

9 5A 1948 2016 .68 .70 .66

10 5B 1938 2016 .66 .67 .71

11 7A 1964 2016 .72 .75

12 7B 1969 2016 .72

13 7C 1968 2016 .75

14 8A 1964 2016 .71 .78

15 8B 1968 2016 .75

16 9A 1912 2016 .62 .59 .67 .73

17 9B 1912 2016 .38 .54 .62 .59

18 10A 1918 2016 .49 .47 .72 .75

19 10B 1915 2016 .60 .55 .78 .79

20 11A 1906 2016 .54 .51 .80 .77

21 11B 1906 2016 .57 .42 .71 .70

22 12A 1890 2016 .27A .46 .49 .73 .68

23 12B 1908 2016 .49 .57 .78 .80

24 13A 1946 2016 .57 .54 .62

25 13B 1947 2016 .62 .60 .43

26 14A 1932 2016 .59 .68 .76

27 14B 1936 2016 .67 .69 .69

28 15A 1943 2016 .54 .43 .33

29 15B 1922 2016 .68 .67 .64 .52

30 16A 1907 2016 .47 .52 .61 .62

31 16B 1907 2016 .58 .69 .75 .72

32 17A 1901 2016 .14B .46 .68 .66

33 17B 1898 2016 .31A .38 .19B .59 .65

34 18A 1926 2016 .50 .73 .81

35 18B 1921 2016 .52 .60 .55 .51

Av segment correlation .45 .51 .54 .63 .62

PART 6: POTENTIAL PROBLEMS: FAGR\_NB\_CORR1-50 08:32 Tue 14 Nov 2017 Page 5

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For each series with potential problems the following diagnostics may appear:

[A] Correlations with master dating series of flagged 50-year segments of series filtered with 32-year spline,

at every point from ten years earlier (-10) to ten years later (+10) than dated

[B] Effect of those data values which most lower or raise correlation with master series

Symbol following year indicates value in series is greater (>) or lesser (<) than master series value

[C] Year-to-year changes very different from the mean change in other series

[D] Absent rings (zero values)

[E] Values which are statistical outliers from mean for the year

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1A 1891 to 2016 126 years Series 1

[B] Entire series, effect on correlation ( .602) is:

Lower 2003< -.032 1978> -.023 1948> -.018 1990> -.015 1956< -.007 1994< -.007 Higher 1949 .024 1996 .016

1A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1891 137 190 138 151 107 156 252 243 192

1900 159 181 186 154 98 119 180 124 98 99

1910 122 95 113 135 108 141 163 146 161 128

1920 172 200 180 127 116 181 167 181 164 131

1930 137 132 161 95 58 58 58 75 68 90

1940 66 48 66 46 59 68 67 79 71 45

1950 51 82 73 75 70 81 61 70 82 85

1960 77 104 93 68 117 114 97 122 120 96

1970 113 94 109 97 113 81 54 65 61 98

1980 96 134 140 108 124 135 180 163 130 128

1990 132 146 117 112 77 83 57 56 90 68

2000 71 85 74 48 85 71 87 93 109 121

2010 98 83 112 107 103 122 95

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1B 1890 to 2016 127 years Series 2

[B] Entire series, effect on correlation ( .494) is:

Lower 1978> -.033 1990> -.013 1890> -.012 1993< -.012 1891< -.012 1971< -.011 Higher 1949 .021 1919 .017

[C] Year-to-year changes diverging by over 4.0 std deviations:

1977 1978 4.0 SD

1B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1890 170 131 180 120 162 145 216 220 196 169

1900 145 129 142 100 65 73 145 136 114 111

1910 168 138 179 187 165 189 195 223 218 123

1920 148 134 155 122 142 212 147 165 165 149

1930 150 163 162 97 42 50 61 71 60 82

1940 48 55 62 83 70 66 59 87 70 52

1950 47 80 87 83 79 116 99 128 145 132

1960 111 133 110 71 124 124 133 145 149 117

1970 127 86 121 101 104 90 89 69 78 123

1980 128 131 164 157 123 110 118 177 164 147

1990 145 142 156 109 101 95 81 72 104 73

2000 89 76 81 75 88 74 79 105 102 121

2010 87 72 85 84 88 127 84

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2A 1890 to 2016 127 years Series 3

[B] Entire series, effect on correlation ( .497) is:

Lower 1896< -.031 1902< -.026 1978> -.015 1949> -.014 1893> -.012 1950< -.012 Higher 2016 .023 1996 .014

2A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1890 230 290 423 338 287 282 189 183 232 215

1900 187 232 164 209 171 171 184 166 140 110

1910 148 127 129 132 123 174 181 144 148 83

1920 101 90 88 57 74 104 138 164 192 121

1930 113 122 114 81 80 95 79 114 103 109

1940 111 114 106 125 160 117 123 202 141 128

1950 72 93 112 99 124 126 96 145 153 154

1960 130 208 192 143 193 195 164 139 130 142

1970 123 136 137 134 102 87 49 56 50 58

1980 93 123 148 154 142 140 140 192 177 138

1990 90 124 155 144 111 106 62 80 58 53

2000 38 72 75 67 105 92 54 74 99 112

2010 99 72 84 95 108 123 70

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2B 1888 to 2016 129 years Series 4

[B] Entire series, effect on correlation ( .487) is:

Lower 2006< -.025 1994< -.019 1893> -.017 1949> -.015 1942< -.013 1986< -.010 Higher 1996 .046 2016 .028

2B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1888 141 191

1890 143 159 218 217 305 292 218 182 198 137

1900 114 111 80 93 82 97 144 116 95 97

1910 118 126 187 201 166 230 241 182 147 110

1920 133 122 101 102 104 121 162 167 163 121

1930 146 113 111 90 82 69 58 59 60 55

1940 63 72 62 61 86 75 85 123 81 99

1950 75 114 106 132 142 166 112 153 125 128

1960 107 129 113 98 138 122 117 104 118 164

1970 154 183 171 210 154 156 95 118 79 119

1980 100 114 96 99 106 94 83 84 83 91

1990 78 79 108 104 77 108 59 75 103 131

2000 105 122 115 105 156 101 74 80 87 81

2010 73 74 79 87 100 100 61

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3A 1881 to 2016 136 years Series 5

[B] Entire series, effect on correlation ( .495) is:

Lower 1924< -.021 1963> -.018 1978> -.010 2010> -.009 1961< -.009 1900> -.008 Higher 1948 .012 1932 .008

3A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1881 128 115 113 86 150 160 126 101 198

1890 98 238 374 252 259 340 461 372 421 405

1900 500 469 379 436 324 322 375 366 286 234

1910 316 246 228 294 292 376 295 272 276 217

1920 255 237 190 203 131 157 187 202 176 160

1930 148 158 200 152 120 141 147 123 132 147

1940 152 139 126 107 105 73 85 68 47 44

1950 44 47 51 50 46 73 54 58 53 58

1960 55 46 46 49 53 47 40 42 44 44

1970 39 40 46 49 46 46 31 26 20 22

1980 21 23 23 25 29 28 32 37 35 37

1990 30 40 31 36 38 44 31 23 18 19

2000 27 37 41 46 56 62 51 71 73 104

2010 114 84 104 83 114 138 130

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3B 1876 to 2016 141 years Series 6

[\*] Early part of series cannot be checked from 1876 to 1879 -- not matched by another series

[B] Entire series, effect on correlation ( .394) is:

Lower 2016> -.022 1880< -.018 1942< -.012 1949> -.011 1951< -.009 1945< -.008 Higher 1948 .023 1904 .008

3B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1876 95 166 174 115

1880 83 83 91 77 70 116 88 67 76 122

1890 93 239 334 263 196 178 306 315 320 246

1900 333 436 418 390 214 218 215 206 195 165

1910 168 154 125 153 135 158 192 187 202 162

1920 183 213 162 174 112 168 183 191 167 146

1930 139 159 190 164 123 135 147 138 110 134

1940 101 91 70 69 85 49 63 61 31 43

1950 37 35 52 43 51 83 76 67 69 75

1960 71 78 81 74 76 78 67 63 62 63

1970 67 54 56 56 45 53 36 38 33 30

1980 39 40 42 42 38 34 32 32 28 30

1990 28 46 43 47 71 74 56 42 28 56

2000 41 67 59 78 77 84 79 104 113 132

2010 106 84 90 61 69 72 93

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4A 1880 to 2016 137 years Series 7

[B] Entire series, effect on correlation ( .461) is:

Lower 1978> -.030 1888> -.024 1986< -.023 1880> -.015 1949> -.012 1960< -.010 Higher 1948 .023 1996 .020

[E] Outliers 2 3.0 SD above or -4.5 SD below mean for year

1888 +3.3 SD; 1986 -5.0 SD

4A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1880 157 118 92 108 56 74 91 108 247 256

1890 153 213 344 169 258 238 316 313 220 142

1900 219 389 382 395 297 333 376 310 267 204

1910 239 187 174 230 215 287 260 249 269 236

1920 244 300 268 265 234 247 250 275 247 233

1930 237 238 269 200 140 153 200 197 171 178

1940 181 129 114 142 124 92 103 116 68 69

1950 64 68 60 58 84 102 83 78 63 71

1960 58 72 85 67 97 108 100 101 99 104

1970 111 106 121 115 86 84 56 39 35 42

1980 30 39 34 37 31 17 11 20 18 23

1990 18 24 26 32 40 49 31 27 25 39

2000 45 59 62 73 116 122 125 145 165 212

2010 143 99 90 71 93 125 124

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4B 1901 to 2016 116 years Series 8

[B] Entire series, effect on correlation ( .489) is:

Lower 1978> -.040 1960< -.018 1949> -.016 2016> -.010 1919> -.009 1945< -.009 Higher 1948 .025 1964 .010

4B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1901 263 216 194 144 156 191 144 144 136

1910 159 150 156 233 223 356 309 267 322 268

1920 231 284 221 198 191 196 257 265 249 210

1930 262 270 322 243 174 225 218 226 175 189

1940 161 136 187 191 188 126 148 214 119 121

1950 100 130 102 79 100 126 96 98 118 118

1960 86 136 109 112 178 165 174 122 123 129

1970 160 167 206 196 131 125 91 75 67 50

1980 48 57 68 106 95 91 84 114 84 103

1990 91 112 81 126 110 132 83 58 48 79

2000 63 76 83 103 105 131 119 143 159 217

2010 118 127 123 102 102 124 123

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5A 1948 to 2016 69 years Series 9

[B] Entire series, effect on correlation ( .626) is:

Lower 1948> -.049 1996> -.034 2004< -.018 1990> -.015 1959< -.013 1989< -.013 Higher 1978 .202 1949 .024

5A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1948 282 176

1950 211 237 254 236 274 318 299 315 262 207

1960 241 286 270 223 345 287 291 308 314 346

1970 301 331 345 338 263 204 274 199 57 175

1980 191 250 248 264 241 227 296 263 244 183

1990 234 278 289 329 324 254 219 126 275 181

2000 209 154 217 211 174 147 149 182 228 288

2010 228 218 268 190 271 285 228

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5B 1938 to 2016 79 years Series 10

[B] Entire series, effect on correlation ( .639) is:

Lower 1948> -.031 1941< -.018 1953< -.009 1972< -.007 1989< -.007 1979> -.007 Higher 1978 .096 1949 .026

5B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1938 181 189

1940 191 161 222 208 221 204 199 204 213 154

1950 187 247 226 165 213 211 224 245 237 184

1960 218 238 215 178 242 273 245 275 250 259

1970 241 172 172 182 161 154 189 180 88 226

1980 242 328 300 295 275 237 267 243 236 198

1990 213 230 291 309 362 321 197 145 264 239

2000 269 207 313 272 305 203 205 245 331 371

2010 260 214 236 250 264 323 221

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7A 1964 to 2016 53 years Series 11

[B] Entire series, effect on correlation ( .746) is:

Lower 1974< -.036 2010> -.008 1969< -.008 1978> -.007 1965> -.005 2008< -.005 Higher 1996 .031 2016 .023

7A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1964 210 219 181 151 131 100

1970 96 140 137 157 91 111 82 100 54 85

1980 113 142 164 209 248 180 259 217 141 183

1990 83 136 126 172 140 100 56 72 77 122

2000 112 128 118 144 253 193 190 262 232 293

2010 262 230 243 175 196 295 204

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7B 1969 to 2016 48 years Series 12

[B] Entire series, effect on correlation ( .715) is:

Lower 1978> -.043 1970< -.017 2014< -.014 1988< -.014 2002< -.013 1971> -.011 Higher 1996 .057 2009 .009

7B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1969 129

1970 107 167 150 176 141 147 107 113 68 96

1980 83 118 160 225 255 162 251 206 110 167

1990 62 134 130 209 183 159 67 97 88 119

2000 112 139 107 127 204 188 190 237 278 339

2010 254 234 322 202 173 278 209

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7C 1968 to 2016 49 years Series 13

[B] Entire series, effect on correlation ( .750) is:

Lower 2008< -.027 2000> -.022 2009< -.016 2010> -.016 2002< -.014 1986< -.013 Higher 1978 .192 1996 .022

7C Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1968 176 179

1970 216 244 234 195 217 239 141 174 68 162

1980 208 252 230 253 245 188 163 230 187 215

1990 162 164 231 197 175 161 99 96 127 123

2000 207 150 110 149 189 148 123 165 135 144

2010 173 145 204 162 184 194 161

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8A 1964 to 2016 53 years Series 14

[B] Entire series, effect on correlation ( .739) is:

Lower 1964< -.044 2006< -.016 2013> -.012 2000> -.009 1969> -.009 2011< -.008 Higher 1978 .066 1996 .051

8A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1964 195 213 192 199 238 244

1970 211 198 172 162 116 139 93 87 47 112

1980 153 138 143 152 128 127 114 180 153 166

1990 93 129 195 184 142 145 65 102 141 169

2000 215 216 157 203 267 190 137 209 242 301

2010 249 157 262 257 247 318 191

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8B 1968 to 2016 49 years Series 15

[B] Entire series, effect on correlation ( .755) is:

Lower 1985< -.015 2013> -.013 1970< -.011 1986< -.011 1988< -.009 2003< -.009 Higher 1996 .048 2016 .023

8B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1968 114 106

1970 80 97 117 211 171 170 141 130 48 100

1980 108 144 121 145 173 84 75 96 67 81

1990 55 111 121 166 145 147 52 82 134 203

2000 209 170 159 108 233 259 312 357 362 397

2010 320 210 296 309 271 363 213

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9A 1912 to 2016 105 years Series 16

[B] Entire series, effect on correlation ( .641) is:

Lower 1959< -.014 1919< -.011 1916< -.011 2011> -.011 1964< -.010 1922> -.009 Higher 1996 .024 1949 .022

9A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1912 61 69 80 93 75 126 107 46

1920 71 90 120 80 60 69 126 121 113 175

1930 108 146 199 144 152 192 166 306 295 373

1940 305 208 220 190 259 281 271 273 198 135

1950 199 318 260 248 325 355 318 264 252 185

1960 276 327 268 203 209 217 208 240 229 240

1970 196 201 205 252 202 159 124 123 83 103

1980 99 145 152 149 146 154 166 162 104 123

1990 101 150 94 122 115 91 31 40 31 63

2000 54 68 66 69 92 103 163 207 246 270

2010 171 209 145 103 142 171 108

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9B 1912 to 2016 105 years Series 17

[B] Entire series, effect on correlation ( .504) is:

Lower 1919> -.051 1913< -.013 1969< -.012 1915< -.011 1976> -.010 1990> -.010 Higher 1978 .055 1996 .046

[E] Outliers 1 3.0 SD above or -4.5 SD below mean for year

1919 +3.3 SD

9B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1912 63 41 49 45 69 95 62 98

1920 62 64 61 66 48 61 94 72 52 83

1930 62 75 118 87 104 175 121 103 81 245

1940 182 117 145 111 191 221 213 236 180 89

1950 143 305 236 213 324 334 297 209 226 151

1960 263 284 246 174 277 236 192 185 192 119

1970 123 131 121 135 173 117 128 88 50 48

1980 62 93 69 66 69 102 137 116 115 91

1990 100 146 123 135 127 98 61 73 72 132

2000 151 152 166 136 152 149 229 193 218 243

2010 155 174 137 74 76 98 78

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10A 1918 to 2016 99 years Series 18

[B] Entire series, effect on correlation ( .641) is:

Lower 1931< -.021 1934> -.016 1949> -.014 1958< -.011 1963> -.010 1923> -.010 Higher 1978 .084 1996 .034

10A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1918 119 81

1920 98 114 113 116 101 96 125 132 90 92

1930 69 54 109 98 136 169 170 138 163 196

1940 112 106 176 118 183 164 166 162 118 141

1950 136 194 133 194 201 210 213 237 161 185

1960 185 204 204 176 219 163 137 125 147 148

1970 142 127 167 129 124 97 106 110 58 101

1980 151 158 156 121 88 72 91 112 170 135

1990 128 161 119 166 198 158 56 56 119 151

2000 118 135 202 120 198 233 124 152 164 245

2010 100 60 70 81 89 84 53

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10B 1915 to 2016 102 years Series 19

[B] Entire series, effect on correlation ( .709) is:

Lower 1990> -.025 1943< -.017 1934> -.016 1933> -.010 1975< -.009 1998> -.008 Higher 1978 .100 1996 .021

10B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1915 136 158 165 155 104

1920 98 128 105 86 79 81 105 112 72 78

1930 69 67 122 116 117 117 111 85 129 143

1940 100 97 114 74 119 114 120 134 91 99

1950 97 138 117 151 149 192 193 215 144 164

1960 214 230 199 149 194 157 152 139 143 122

1970 159 135 155 136 118 89 113 105 46 85

1980 119 138 156 142 136 102 168 157 215 154

1990 182 171 142 187 187 133 52 60 152 117

2000 70 93 101 81 116 126 73 108 152 236

2010 128 61 98 77 115 109 55

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11A 1906 to 2016 111 years Series 20

[B] Entire series, effect on correlation ( .680) is:

Lower 1925< -.012 1976> -.011 1935< -.010 1934> -.009 1989< -.009 2006> -.008 Higher 1978 .058 1996 .021

11A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1906 160 105 113 112

1910 154 146 195 165 169 153 141 144 183 121

1920 124 127 114 61 50 42 69 86 84 105

1930 80 70 109 92 79 54 70 55 74 63

1940 56 61 93 53 50 60 57 66 33 19

1950 27 47 32 62 80 108 101 123 132 108

1960 96 122 119 59 99 133 78 61 78 67

1970 68 135 134 149 148 122 156 154 76 100

1980 150 205 194 155 169 160 163 196 228 158

1990 100 196 236 271 262 191 114 127 177 217

2000 265 251 254 251 319 332 408 323 308 326

2010 227 261 255 190 240 258 151

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11B 1906 to 2016 111 years Series 21

[B] Entire series, effect on correlation ( .636) is:

Lower 1943< -.031 1963> -.019 1933> -.014 1976> -.010 1968< -.009 2014< -.008 Higher 1978 .062 1996 .039

11B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1906 163 112 98 117

1910 158 136 163 143 142 149 129 142 173 108

1920 141 138 109 58 38 56 118 133 96 98

1930 82 68 82 97 80 67 62 67 75 76

1940 79 70 124 52 101 79 102 86 45 43

1950 48 78 36 92 117 100 84 132 104 134

1960 152 181 198 166 177 119 91 79 64 115

1970 83 123 124 122 109 109 157 173 69 95

1980 182 250 210 180 215 156 163 176 219 172

1990 115 212 228 254 188 226 132 162 220 241

2000 280 241 278 205 260 291 341 391 327 326

2010 274 275 241 247 176 206 154

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12A 1890 to 2016 127 years Series 22

[A] Segment High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10

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1890 1939 0 .27 -.14 -.18 -.18 .17 .25 -.26 -.16 -.01 .01 .27\* .03 -.04 -.09 .26 .10 -.13 -.21 -.23 -.02 .06

[B] Entire series, effect on correlation ( .537) is:

Lower 1892< -.030 1890> -.019 1939< -.018 1924> -.017 2016> -.015 1902> -.013 Higher 1978 .114 1948 .018

1890 to 1939 segment:

Lower 1892< -.080 1890> -.048 1939< -.045 1924> -.045 1902> -.025 1904> -.023 Higher 1919 .099 1932 .036

12A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1890 134 149 109 89 135 105 98 102 91 96

1900 66 81 177 128 113 81 65 58 65 53

1910 91 89 101 85 87 126 155 129 127 66

1920 68 98 97 90 114 106 117 123 122 95

1930 98 106 152 141 112 113 107 116 145 109

1940 123 109 147 140 170 197 164 143 96 108

1950 106 164 161 145 164 189 138 158 159 181

1960 183 190 200 178 205 171 136 121 172 119

1970 137 122 155 127 155 165 152 169 66 123

1980 181 267 303 211 197 116 164 192 219 198

1990 102 168 156 240 142 89 69 48 55 86

2000 66 98 125 133 172 126 227 246 176 248

2010 177 105 134 76 80 68 91

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12B 1908 to 2016 109 years Series 23

[B] Entire series, effect on correlation ( .665) is:

Lower 1922< -.029 1919> -.020 2016> -.010 1911> -.010 1996> -.008 1956< -.008 Higher 1978 .109 1990 .007

12B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1908 66 51

1910 69 100 124 143 115 111 135 137 124 132

1920 127 153 79 77 91 97 162 156 173 176

1930 146 177 178 142 110 150 172 187 172 165

1940 151 134 190 176 227 249 224 195 165 126

1950 125 185 164 132 147 164 118 133 145 186

1960 175 236 212 181 203 167 148 131 178 159

1970 181 174 194 167 152 168 152 206 75 140

1980 196 276 295 263 217 170 267 206 203 154

1990 62 212 180 203 168 135 100 74 69 116

2000 130 161 147 136 202 191 202 248 203 182

2010 89 59 109 80 96 145 109

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13A 1946 to 2016 71 years Series 24

[B] Entire series, effect on correlation ( .587) is:

Lower 1950> -.019 1973< -.018 1991< -.017 1955< -.015 1996> -.012 1990< -.010 Higher 1978 .079 2016 .029

13A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1946 123 117 74 72

1950 129 149 122 89 114 107 135 142 113 162

1960 181 176 174 133 181 136 123 137 151 118

1970 136 153 232 148 190 198 192 228 95 87

1980 147 220 232 236 303 275 276 209 225 236

1990 70 84 218 253 252 217 157 137 219 240

2000 259 175 166 169 323 300 297 232 201 215

2010 162 193 242 211 203 255 153

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13B 1947 to 2016 70 years Series 25

[B] Entire series, effect on correlation ( .469) is:

Lower 2014< -.065 1996> -.033 2009< -.020 2013> -.015 2010> -.015 1976> -.009 Higher 1978 .115 2004 .011

13B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1947 180 108 93

1950 136 221 168 140 152 146 167 198 186 129

1960 143 185 203 138 146 131 131 118 142 117

1970 120 115 161 177 200 140 165 202 83 82

1980 160 221 284 296 256 186 204 183 219 190

1990 67 118 203 256 191 164 179 104 173 180

2000 216 244 293 217 296 268 212 201 202 173

2010 265 232 263 269 120 182 189

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14A 1932 to 2016 85 years Series 26

[B] Entire series, effect on correlation ( .662) is:

Lower 1932< -.022 1947< -.015 1966< -.013 1991< -.010 1934> -.010 1961< -.010 Higher 1978 .029 1996 .027

14A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1932 85 68 111 186 147 163 198 241

1940 231 209 275 239 229 207 193 168 144 138

1950 148 193 187 181 199 178 193 221 183 166

1960 178 165 200 152 156 159 129 148 157 133

1970 148 173 179 154 107 131 126 147 73 78

1980 127 170 239 214 271 200 295 222 235 210

1990 97 79 137 138 161 114 55 45 68 121

2000 131 129 116 104 117 126 157 188 188 172

2010 123 118 149 147 119 165 95

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14B 1936 to 2016 81 years Series 27

[B] Entire series, effect on correlation ( .657) is:

Lower 2004< -.040 1990< -.017 1968< -.015 1976> -.013 1955< -.010 1961< -.009 Higher 1978 .080 1996 .040

14B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1936 152 212 270 333

1940 359 335 425 426 368 398 471 426 326 252

1950 252 292 302 296 372 299 323 354 276 260

1960 287 251 247 197 207 204 174 184 151 161

1970 169 199 181 172 208 197 207 179 75 78

1980 132 179 184 143 177 167 218 173 166 201

1990 74 98 123 111 109 115 61 60 103 115

2000 103 109 121 111 82 101 104 164 174 182

2010 119 116 142 142 136 178 138

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15A 1943 to 2016 74 years Series 28

[B] Entire series, effect on correlation ( .397) is:

Lower 1971< -.073 2009< -.057 1996> -.051 2016> -.016 1954< -.015 1998< -.010 Higher 1978 .127 1949 .023

15A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1943 355 278 236 207 308 228 180

1950 242 426 404 304 239 360 362 381 374 303

1960 292 402 335 276 340 292 259 276 276 300

1970 260 158 200 221 167 180 137 176 112 186

1980 210 237 271 262 210 238 262 277 187 208

1990 175 175 168 166 180 133 158 136 91 94

2000 82 137 133 150 171 179 152 170 174 86

2010 95 84 100 86 125 162 135

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15B 1922 to 2016 95 years Series 29

[B] Entire series, effect on correlation ( .587) is:

Lower 1996> -.037 2009< -.034 1962< -.014 2016> -.011 1998> -.010 1943> -.009 Higher 1978 .080 1949 .029

15B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 80 73 56 130 202 225 216 204

1930 185 282 289 183 199 186 183 289 284 389

1940 370 294 321 433 363 320 353 410 306 145

1950 171 354 327 275 299 353 322 337 318 253

1960 229 357 286 235 404 345 292 312 327 368

1970 317 327 412 385 268 230 186 149 71 171

1980 171 216 254 251 197 243 261 265 169 179

1990 164 199 157 142 165 160 144 115 151 155

2000 105 101 88 72 98 84 90 109 118 84

2010 95 84 111 98 116 162 128

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16A 1907 to 2016 110 years Series 30

[B] Entire series, effect on correlation ( .579) is:

Lower 1996> -.018 1929< -.015 1997> -.012 1924> -.011 1922> -.010 1994< -.009 Higher 1978 .127 1948 .018

16A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1907 76 54 65

1910 127 159 217 174 160 185 218 186 215 146

1920 239 191 234 181 179 158 150 167 125 76

1930 83 145 166 141 109 197 222 236 171 235

1940 265 236 364 304 256 277 248 322 200 219

1950 260 263 270 209 227 283 304 338 367 292

1960 330 377 300 192 261 273 236 210 283 254

1970 273 246 229 207 270 210 177 193 62 53

1980 130 138 117 91 80 114 110 133 125 177

1990 144 132 141 327 148 104 100 143 93 70

2000 89 103 95 132 215 149 141 167 158 153

2010 90 90 89 87 119 91 63

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16B 1907 to 2016 110 years Series 31

[B] Entire series, effect on correlation ( .674) is:

Lower 1997> -.025 1990> -.021 1922> -.018 1924> -.015 1949> -.007 2005< -.007 Higher 1978 .104 1996 .016

16B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1907 46 43 68

1910 140 145 148 180 171 183 196 223 225 173

1920 322 261 308 216 215 226 242 222 139 138

1930 127 164 201 167 125 147 129 190 193 207

1940 169 167 257 255 236 262 283 388 271 235

1950 246 372 336 271 330 348 310 337 305 309

1960 384 408 403 301 397 403 310 300 339 290

1970 298 278 285 259 220 243 210 263 99 97

1980 225 281 286 313 310 305 332 331 218 208

1990 265 210 180 189 249 216 142 220 192 160

2000 180 152 173 159 177 120 121 174 224 232

2010 109 114 145 104 176 163 77

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17A 1901 to 2016 116 years Series 32

[A] Segment High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10

--------- ---- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---

1901 1950 1 .10 -.05 -.14 .15 .02 -.18 .09 .09 -.01 .16 .14| .33\* .02 -.36 -.11 .02 -.01 -.29 .03 -.21 -.02

[B] Entire series, effect on correlation ( .424) is:

Lower 1904> -.042 2009< -.028 1919> -.025 1903< -.017 1906< -.017 1924> -.015 Higher 1978 .144 1996 .035

1901 to 1950 segment:

Lower 1904> -.091 1919> -.050 1906< -.038 1903< -.033 1918< -.031 1924> -.030 Higher 1948 .079 1916 .043

[C] Year-to-year changes diverging by over 4.0 std deviations:

1903 1904 4.3 SD

[E] Outliers 1 3.0 SD above or -4.5 SD below mean for year

1904 +3.2 SD

17A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1901 18 38 13 93 79 39 41 84 85

1910 78 41 69 104 82 109 333 276 151 228

1920 243 228 191 130 189 175 221 265 174 148

1930 153 101 117 127 121 101 122 97 135 145

1940 167 158 163 178 227 222 277 300 170 145

1950 141 212 124 189 180 147 180 207 271 280

1960 290 311 288 259 309 233 186 236 242 235

1970 271 301 397 388 293 277 252 230 108 161

1980 279 347 294 217 223 207 187 220 238 248

1990 202 173 169 223 153 157 108 165 220 258

2000 269 280 295 365 337 299 239 266 310 212

2010 201 214 243 179 198 232 205

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17B 1898 to 2016 119 years Series 33

[A] Segment High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10

--------- ---- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---

1898 1947 0 .18 -.17 -.03 -.01 -.20 -.01 -.16 -.07 -.08 -.12 .31\* .00 .06 .07 .17 .25 -.09 -.18 -.16 -.05 -.01

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

1925 1974 4 -.08 -.05 -.18 .01 .03 -.04 -.18 .05 .19 -.17 .19| .21 .04 .10 .33\* .14 -.17 -.24 -.14 -.19 -.03

[B] Entire series, effect on correlation ( .490) is:

Lower 1965< -.022 2009< -.020 1963> -.016 1931< -.015 1990> -.013 1901< -.013 Higher 1978 .144 1996 .050

1898 to 1947 segment:

Lower 1901< -.041 1931< -.040 1932< -.038 1908> -.034 1941> -.021 1899> -.021 Higher 1919 .084 1942 .034

1925 to 1974 segment:

Lower 1963> -.040 1965< -.038 1932< -.027 1931< -.024 1941> -.020 1936> -.015 Higher 1948 .044 1949 .041

17B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1898 46 81

1900 33 5 14 26 14 88 92 56 71 64

1910 70 54 76 72 68 76 97 86 68 40

1920 73 88 52 56 53 48 87 87 80 52

1930 50 25 34 56 73 66 94 101 91 83

1940 103 121 191 163 121 60 72 96 71 61

1950 81 115 65 127 119 111 127 213 209 202

1960 220 202 163 178 205 117 123 190 162 198

1970 178 161 155 138 124 183 171 217 113 151

1980 159 208 180 139 142 141 159 159 171 253

1990 236 219 147 192 182 163 83 130 200 210

2000 206 225 290 313 297 248 208 235 271 182

2010 171 158 173 141 190 256 200

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18A 1926 to 2016 91 years Series 34

[B] Entire series, effect on correlation ( .655) is:

Lower 1948> -.035 1990> -.022 1961< -.020 1957< -.016 1939< -.012 1952> -.008 Higher 1978 .055 1996 .035

18A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1926 178 171 171 174

1930 165 194 201 122 123 209 138 122 196 148

1940 172 139 189 196 197 179 213 210 229 134

1950 161 231 244 235 262 251 207 200 240 245

1960 246 219 249 206 263 277 257 294 291 247

1970 242 221 270 252 226 195 149 159 65 76

1980 152 177 244 245 218 235 279 232 209 189

1990 233 232 236 240 237 159 76 113 155 165

2000 196 153 161 127 237 193 224 196 229 258

2010 187 138 178 184 216 220 141

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18B 1921 to 2016 96 years Series 35

[B] Entire series, effect on correlation ( .504) is:

Lower 1997> -.021 1924> -.014 2011> -.014 1921< -.013 2007< -.012 1948> -.011 Higher 1949 .041 2016 .031

18B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1921 108 108 166 209 285 249 192 157 172

1930 196 237 255 198 204 254 180 155 193 214

1940 257 246 297 281 248 242 250 276 256 154

1950 180 292 251 212 279 266 300 360 292 220

1960 246 258 266 193 258 268 249 283 287 286

1970 266 264 256 267 258 254 239 176 83 53

1980 122 166 202 231 288 279 348 289 239 145

1990 176 230 212 223 291 219 119 199 212 183

2000 148 121 127 139 215 181 172 152 187 267

2010 208 208 195 189 197 187 151

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Corr //-------- Unfiltered --------\\ //---- Filtered -----\\

No. No. No. with Mean Max Std Auto Mean Max Std Auto AR

Seq Series Interval Years Segmt Flags Master msmt msmt dev corr sens value dev corr ()

--- -------- --------- ----- ----- ----- ------ ----- ----- ----- ----- ----- ----- ----- ----- --

1 1A 1891 2016 126 5 0 .602 1.10 2.52 .421 .791 .199 2.59 .474 .027 1

2 1B 1890 2016 127 5 0 .494 1.18 2.23 .424 .772 .192 2.63 .491 .025 1

3 2A 1890 2016 127 5 0 .497 1.33 4.23 .589 .833 .199 2.79 .426 -.010 1

4 2B 1888 2016 129 5 0 .487 1.20 3.05 .465 .808 .180 2.74 .478 -.064 3

5 3A 1881 2016 136 5 0 .495 1.36 5.00 1.194 .943 .172 2.50 .336 -.011 1

6 3B 1876 2016 141 5 0 .394 1.15 4.36 .827 .912 .182 2.48 .378 -.078 1

7 4A 1880 2016 137 5 0 .461 1.44 3.95 .963 .906 .201 2.59 .450 -.008 2

8 4B 1901 2016 116 4 0 .489 1.52 3.56 .669 .847 .187 2.83 .498 -.061 1

9 5A 1948 2016 69 3 0 .626 2.47 3.46 .580 .536 .205 2.34 .347 .030 1

10 5B 1938 2016 79 3 0 .639 2.32 3.71 .519 .536 .169 2.54 .445 -.053 2

11 7A 1964 2016 53 2 0 .746 1.61 2.95 .633 .722 .255 2.70 .642 -.101 1

12 7B 1969 2016 48 1 0 .715 1.66 3.39 .667 .647 .289 2.59 .575 -.084 1

13 7C 1968 2016 49 1 0 .750 1.77 2.53 .437 .481 .223 2.43 .406 .052 1

14 8A 1964 2016 53 2 0 .739 1.75 3.18 .584 .661 .241 2.44 .517 .036 1

15 8B 1968 2016 49 1 0 .755 1.70 3.97 .923 .824 .285 2.59 .501 -.012 1

16 9A 1912 2016 105 4 0 .641 1.67 3.73 .810 .846 .231 2.60 .405 .040 1

17 9B 1912 2016 105 4 0 .504 1.36 3.34 .704 .778 .257 2.78 .532 .095 1

18 10A 1918 2016 99 4 0 .641 1.37 2.45 .450 .570 .234 2.61 .471 .037 1

19 10B 1915 2016 102 4 0 .709 1.26 2.36 .410 .611 .236 2.59 .354 .038 1

20 11A 1906 2016 111 4 0 .680 1.39 4.08 .790 .890 .230 2.62 .466 .078 1

21 11B 1906 2016 111 4 0 .636 1.47 3.91 .739 .860 .242 2.65 .465 -.003 1

22 12A 1890 2016 127 5 1 .537 1.32 3.03 .482 .678 .222 2.71 .377 .006 1

23 12B 1908 2016 109 4 0 .665 1.56 2.95 .496 .661 .215 2.49 .349 .015 1

24 13A 1946 2016 71 3 0 .587 1.80 3.23 .614 .636 .221 2.51 .468 -.006 2

25 13B 1947 2016 70 3 0 .469 1.80 2.96 .547 .569 .233 2.54 .493 -.058 2

26 14A 1932 2016 85 3 0 .662 1.59 2.95 .509 .728 .195 2.73 .540 .012 1

27 14B 1936 2016 81 3 0 .657 2.03 4.71 .980 .909 .170 2.49 .452 .039 1

28 15A 1943 2016 74 3 0 .397 2.17 4.26 .877 .820 .189 2.55 .466 -.012 1

29 15B 1922 2016 95 4 0 .587 2.23 4.33 1.001 .832 .201 2.53 .415 .095 2

30 16A 1907 2016 110 4 0 .579 1.83 3.77 .787 .777 .226 2.80 .368 .098 1

31 16B 1907 2016 110 4 0 .674 2.25 4.08 .833 .792 .187 2.60 .351 .074 2

32 17A 1901 2016 116 4 1 .424 1.98 3.97 .819 .799 .231 2.68 .402 .009 1

33 17B 1898 2016 119 5 2 .490 1.32 3.13 .691 .863 .259 2.51 .365 -.060 2

34 18A 1926 2016 91 3 0 .655 1.99 2.94 .489 .641 .179 2.43 .405 .084 1

35 18B 1921 2016 96 4 0 .504 2.19 3.60 .578 .679 .182 2.59 .409 .054 2

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Total or mean: 3426 128 4 .570 1.61 5.00 .678 .767 .211 2.83 .435 .010

- = [ COFECHA FAGR COF ] = -