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[] P R O G R A M C O F E C H A Version 6.06P 30164

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QUALITY CONTROL AND DATING CHECK OF TREE-RING MEASUREMENTS

Title of run: MMRB1400B\_BEAL\_Corr4-50

File of DATED series: MMRB1400B\_BEAL\_Corr4

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 1899 to 2015 117 years

Continuous time span is 1899 to 2015 117 years

Portion with two or more series is 1908 to 2015 108 years

>> 1177B 1990 absent in 1 of 26 series, but is not usually narrow: master index is .084

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

\*C\* Number of dated series 26 \*C\*

\*O\* Master series 1899 2015 117 yrs \*O\*

\*F\* Total rings in all series 2155 \*F\*

\*E\* Total dated rings checked 2146 \*E\*

\*C\* Series intercorrelation .530 \*C\*

\*H\* Average mean sensitivity .288 \*H\*

\*A\* Segments, possible problems 9 \*A\*

\*\*\* Mean length of series 82.9 \*\*\*

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

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

598A 1 absent rings: 2003

1071A 1 absent rings: 2006

1173B 2 absent rings: 1974 2001

1177A 1 absent rings: 2010

1177B 1 absent rings: 1990

6 absent rings .278%

PART 2: TIME PLOT OF TREE-RING SERIES: MMRB1400B\_BEAL\_Corr4-50 14:11 Mon 31 Jul 2017 Page 2

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1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050 Ident Seq Time-span Yrs

: : : : : : : : : : : : : : : : : : : : : -------- --- ---- ---- ----

. . . . . . . . . . . . . . . . . . <========> . 103A 1 1929 2015 87

. . . . . . . . . . . . . . . . . . <======> . 103B 2 1941 2015 75

. . . . . . . . . . . . . . . . . . <=====> . 597A 3 1952 2015 64

. . . . . . . . . . . . . . . . . . <========> . 598A 4 1923 2015 93

. . . . . . . . . . . . . . . . . . <=======> . 598B 5 1934 2015 82

. . . . . . . . . . . . . . . . . . <========> . 599A 6 1923 2015 93

. . . . . . . . . . . . . . . . . . <=======> . 599B 7 1930 2015 86

. . . . . . . . . . . . . . . . . . <========> . 600A 8 1925 2015 91

. . . . . . . . . . . . . . . . . . <========> . 600B 9 1926 2015 90

. . . . . . . . . . . . . . . . . <===========> . 1071A 10 1899 2015 117

. . . . . . . . . . . . . . . . . .<=========> . 1071B 11 1911 2015 105

. . . . . . . . . . . . . . . . . . <======> . 1072A 12 1944 2015 72

. . . . . . . . . . . . . . . . . . <======> . 1072B 13 1941 2015 75

. . . . . . . . . . . . . . . . . <==========> . 1073A 14 1908 2015 108

. . . . . . . . . . . . . . . . . . <=======> . 1073B 15 1930 2015 86

. . . . . . . . . . . . . . . . . . <=======> . 1075A 16 1936 2015 80

. . . . . . . . . . . . . . . . . . . <===> . 1075B 17 1975 2015 41

. . . . . . . . . . . . . . . . . . <=====> . 1154A 18 1955 2015 61

. . . . . . . . . . . . . . . . . . <========> . 1154B 19 1925 2015 91

. . . . . . . . . . . . . . . . . . <========> . 1155A 20 1920 2015 96

. . . . . . . . . . . . . . . . . . <========> . 1155B 21 1921 2015 95

. . . . . . . . . . . . . . . . . . <======> . 1173A 22 1946 2015 70

. . . . . . . . . . . . . . . . . . <=====> . 1173B 23 1952 2015 64

. . . . . . . . . . . . . . . . . . <========> . 1177A 24 1928 2015 88

. . . . . . . . . . . . . . . . . . <=======> . 1177B 25 1935 2015 81

. . . . . . . . . . . . . . . . . . <=====> . 597B 26 1952 2015 64

: : : : : : : : : : : : : : : : : : : : :

1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050

PART 3: Master Dating Series: MMRB1400B\_BEAL\_Corr4-50 14:11 Mon 31 Jul 2017 Page 3

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Year Value No Ab Year Value No Ab Year Value No Ab Year Value No Ab Year Value No Ab Year Value No Ab

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1900 .987 1 1950 .288 21 2000 -.033 26

1901 1.242 1 1951 1.428 21 2001 -.900 26 1

1902 2.382 1 1952 1.486 24 2002 -.077 26

1903 .978 1 1953 .915 24 2003 -.432 26 1

1904 1.061 1 1954 .609 24 2004 1.355 26

1905 1.252 1 1955 .780 25 2005 -.042 26

1906 .813 1 1956 .383 25 2006 -.762 26 1

1907 .674 1 1957 .025 25 2007 -.444 26

1908 .861 2 1958 .740 25 2008 .048 26

1909 .592 2 1959 -.126 25 2009 1.019 26

1910 .106 2 1960 -.588 25 2010 -2.235 26 1

1911 .244 3 1961 -.327 25 2011 -.342 26

1912 -.633 3 1962 -1.293 25 2012 .477 26

1913 -.970 3 1963 -.386 25 2013 -.209 26

1914 -1.131 3 1964 .827 25 2014 1.956 26

1915 -1.295 3 1965 .927 25 2015 -.445 26

1916 -1.305 3 1966 -1.310 25

1917 -1.743 3 1967 .118 25

1918 -2.023 3 1968 -.492 25

1919 -.193 3 1969 -.250 25

1920 2.242 4 1970 1.032 25

1921 .459 5 1971 -.399 25

1922 1.471 5 1972 .342 25

1923 .344 7 1973 .667 25

1924 -.004 7 1974 -.793 25 1

1925 .287 9 1975 -1.960 26

1926 .178 10 1976 -1.891 26

1927 .325 10 1977 -.004 26

1928 .517 11 1978 1.174 26

1929 .624 12 1979 .097 26

1930 .031 14 1980 .964 26

1931 .322 14 1981 .564 26

1932 .389 14 1982 1.471 26

1933 -.498 14 1983 .529 26

1934 .474 15 1984 .117 26

1935 .817 16 1985 -.242 26

1936 -2.565 17 1986 -1.360 26

1937 -1.422 17 1987 -1.409 26

1938 .243 17 1988 .202 26

1939 .422 17 1989 -.214 26

1940 -.016 17 1990 .084 26 1<<

1941 -.803 19 1991 -.243 26

1942 .145 19 1992 .169 26

1943 .361 19 1993 .832 26

1944 -.094 20 1994 1.459 26

1945 -1.940 20 1995 .201 26

1946 -1.869 21 1996 -.134 26

1947 .385 21 1997 -.357 26

1948 -3.394 21 1998 -1.128 26

1899 -.983 1 1949 -.365 21 1999 -.441 26

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PART 4: Master Bar Plot: MMRB1400B\_BEAL\_Corr4-50 14:11 Mon 31 Jul 2017 Page 4

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Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value

1900---------D 1950------A 2000----@

1901----------E 1951----------F 2001-d

1902----------J 1952----------F 2002----@

1903---------D 1953---------D 2003--b

1904---------D 1954--------B 2004----------E

1905----------E 1955--------C 2005----@

1906--------C 1956-------B 2006--c

1907--------C 1957----@ 2007--b

1908--------C 1958--------C 2008-----@

1909-------B 1959----a 2009---------D

1910-----@ 1960--b 2010i

1911------A 1961---a 2011---a

1912--c 1962-e 2012-------B

1913-d 1963---b 2013---a

1914-e 1964--------C 2014----------H

1915-e 1965---------D 2015--b

1916-e 1966-e

1917g 1967-----@

1918h 1968--b

1919---a 1969---a

1920----------I 1970---------D

1921-------B 1971---b

1922----------F 1972------A

1923------A 1973--------C

1924----@ 1974--c

1925------A 1975h

1926-----A 1976h

1927------A 1977----@

1928-------B 1978---------E

1929--------B 1979-----@

1930----@ 1980---------D

1931------A 1981-------B

1932-------B 1982----------F

1933--b 1983-------B

1934-------B 1984-----@

1935--------C 1985---a

1936j 1986-e

1937-f 1987-f

1938------A 1988------A

1939-------B 1989---a

1940----@ 1990-----@

1941--c 1991---a

1942-----A 1992-----A

1943------A 1993--------C

1944----@ 1994----------F

1945h 1995------A

1946g 1996----a

1947-------B 1997---a

1948n 1998-e

1899-d 1949---a 1999--b

PART 5: CORRELATION OF SERIES BY SEGMENTS: MMRB1400B\_BEAL\_Corr4-50 14:11 Mon 31 Jul 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 1900 1925 1950 1975

1949 1974 1999 2024

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

1 103A 1929 2015 .71 .57 .54

2 103B 1941 2015 .67 .47 .54

3 597A 1952 2015 .39 .52

4 598A 1923 2015 .57 .60 .64 .63

5 598B 1934 2015 .68 .49 .41

6 599A 1923 2015 .23B .32A .47 .61

7 599B 1930 2015 .56 .47 .58

8 600A 1925 2015 .54 .47 .55

9 600B 1926 2015 .63 .50 .53

10 1071A 1899 2015 .54 .53 .40 .62

11 1071B 1911 2015 .45 .46 .60 .61

12 1072A 1944 2015 .54 .38B .58

13 1072B 1941 2015 .66 .36 .43

14 1073A 1908 2015 .76 .76 .62 .68

15 1073B 1930 2015 .72 .64 .68

16 1075A 1936 2015 .66 .47 .47

17 1075B 1975 2015 .50

18 1154A 1955 2015 .35 .66

19 1154B 1925 2015 .49 .55 .64

20 1155A 1920 2015 .63 .63 .58 .51

21 1155B 1921 2015 .62 .59 .54 .51

22 1173A 1946 2015 .29A .33 .24B

23 1173B 1952 2015 .38 .36B

24 1177A 1928 2015 .46 .32A .31A

25 1177B 1935 2015 .44 .49 .50

26 597B 1952 2015 .27A .47

Av segment correlation .54 .57 .47 .53

PART 6: POTENTIAL PROBLEMS: MMRB1400B\_BEAL\_Corr4-50 14:11 Mon 31 Jul 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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103A 1929 to 2015 87 years Series 1

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

Lower 1936> -.019 1992< -.018 1979< -.016 1967< -.011 2015> -.010 2003> -.010 Higher 1948 .105 2014 .012

103A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1929 347

1930 302 223 134 120 103 87 73 72 80 76

1940 78 62 83 103 96 76 81 154 59 157

1950 137 176 279 200 237 274 305 278 237 207

1960 176 220 206 216 246 248 183 177 200 256

1970 324 249 282 343 282 195 188 218 218 152

1980 188 197 216 211 183 179 117 132 165 114

1990 117 97 69 87 103 62 54 53 42 62

2000 54 55 80 87 94 67 9 32 22 43

2010 16 18 42 37 148 107

====================================================================================================================================

103B 1941 to 2015 75 years Series 2

[B] Entire series, effect on correlation ( .631) is:

Lower 1986> -.022 1941> -.020 1999< -.020 1967< -.017 1960< -.015 1945> -.015 Higher 1948 .120 1975 .016

103B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1941 128 114 116 87 103 79 153 54 157

1950 183 223 226 182 212 237 282 316 437 309

1960 137 168 192 260 303 331 222 188 222 307

1970 342 323 365 473 310 205 287 374 399 317

1980 396 361 337 266 228 198 270 257 247 239

1990 257 181 210 314 285 147 236 187 170 75

2000 108 80 92 89 111 85 25 31 55 92

2010 36 68 79 102 142 86

====================================================================================================================================

597A 1952 to 2015 64 years Series 3

[B] Entire series, effect on correlation ( .541) is:

Lower 1975> -.037 1980< -.024 1992< -.022 1958< -.016 1968> -.010 2001> -.010 Higher 2010 .052 2014 .013

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

1986 -4.7 SD

597A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1952 33 41 53 82 84 51 48 52

1960 65 78 65 89 146 222 151 241 237 212

1970 213 180 267 333 216 229 188 192 200 153

1980 153 199 247 199 264 159 79 165 235 214

1990 190 184 122 215 217 214 227 155 148 114

2000 126 147 153 108 176 136 95 132 161 239

2010 114 180 221 172 246 141

====================================================================================================================================

598A 1923 to 2015 93 years Series 4

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

Lower 2003< -.088 1929< -.023 2006> -.014 2002< -.010 1971> -.008 1955< -.008 Higher 1936 .051 2014 .019

[D] 1 Absent rings: Year Master N series Absent

2003 -.432 26 1

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

2003 -8.2 SD

598A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1923 216 266 239 224 225 163 107

1930 139 154 116 143 196 198 56 140 194 139

1940 150 116 245 186 167 89 95 152 97 127

1950 160 204 240 215 148 139 161 123 207 214

1960 214 214 175 235 246 215 152 219 208 240

1970 256 237 232 203 169 151 132 163 196 173

1980 175 148 180 159 131 136 113 92 164 133

1990 133 121 112 98 112 84 78 57 37 69

2000 61 55 32 0 52 40 62 38 52 49

2010 35 34 61 43 91 50

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598B 1934 to 2015 82 years Series 5

[B] Entire series, effect on correlation ( .517) is:

Lower 2003< -.134 1977< -.017 1990> -.012 2006> -.007 1937> -.007 1954< -.005 Higher 1948 .034 2010 .023

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

1990 +3.1 SD; 2003 -7.8 SD

598B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1934 199 196 137 204 246 236

1940 198 145 268 225 205 101 113 192 65 189

1950 199 266 258 170 139 151 142 109 172 189

1960 232 207 168 271 373 332 215 239 229 240

1970 254 229 274 202 177 159 134 118 193 150

1980 146 139 182 112 102 93 94 78 119 107

1990 191 101 97 98 98 86 73 69 36 60

2000 69 58 51 13 66 50 56 51 37 46

2010 23 52 66 41 108 59

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599A 1923 to 2015 93 years Series 6

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

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

1923 1972 -1 .10 .08 .07 -.13 -.19 -.06 -.26 .03 -.11 .27\* .23|-.04 -.02 .16 .08 -.21 -.23 -.04 -.07 -.12 .10

1925 1974 0 .07 .03 .10 -.17 -.25 .01 -.21 -.06 -.04 .19 .32\* .01 .06 .16 .07 -.23 -.33 -.03 -.11 -.21 .17

[B] Entire series, effect on correlation ( .414) is:

Lower 1926< -.044 1924< -.041 1936> -.020 1923> -.015 1998< -.014 1972< -.010 Higher 2010 .047 2014 .021

1923 to 1972 segment:

Lower 1926< -.073 1924< -.070 1923> -.023 1972< -.017 1938< -.012 1930> -.009 Higher 1948 .075 1945 .036

1925 to 1974 segment:

Lower 1926< -.100 1972< -.021 1973< -.019 1936> -.017 1938< -.014 1930> -.011 Higher 1948 .061 1945 .034

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

1998 -5.5 SD

599A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1923 206 169 196 143 183 168 160

1930 191 177 175 155 185 167 123 35 70 291

1940 243 134 138 113 74 41 62 103 50 86

1950 81 121 163 190 162 155 88 95 111 74

1960 69 138 119 174 209 237 146 196 168 181

1970 246 148 65 56 35 36 53 155 194 176

1980 193 110 160 134 105 116 104 64 112 78

1990 77 85 136 105 108 120 76 69 26 90

2000 61 58 78 61 98 62 29 57 58 74

2010 24 50 65 54 118 53

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599B 1930 to 2015 86 years Series 7

[B] Entire series, effect on correlation ( .595) is:

Lower 1952< -.024 1977< -.017 1971> -.015 2000< -.010 1933> -.010 2002< -.009 Higher 1948 .033 2010 .020

599B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1930 152 159 146 164 172 198 125 153 150 169

1940 195 171 155 120 114 51 56 86 53 117

1950 156 154 104 136 166 186 188 150 168 156

1960 127 206 167 225 229 256 187 259 234 205

1970 206 257 218 269 222 149 173 162 190 235

1980 273 230 252 211 190 223 182 138 182 148

1990 157 136 166 114 149 124 94 88 31 55

2000 30 35 20 42 97 39 9 16 33 42

2010 11 37 38 39 103 41

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600A 1925 to 2015 91 years Series 8

[B] Entire series, effect on correlation ( .545) is:

Lower 1933< -.044 1990< -.022 2006> -.013 1928< -.012 1996> -.010 1964< -.009 Higher 1945 .021 2010 .020

600A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1925 137 103 121 90 128

1930 108 172 147 51 109 128 70 90 122 121

1940 89 51 66 94 100 35 45 144 63 99

1950 113 156 162 121 101 110 91 91 128 84

1960 88 74 15 32 37 34 38 48 39 53

1970 90 79 98 58 29 43 24 109 213 139

1980 140 89 94 127 86 90 62 75 94 111

1990 53 78 102 142 127 113 156 100 96 84

2000 75 40 48 43 83 48 86 72 64 62

2010 39 73 97 80 176 104

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600B 1926 to 2015 90 years Series 9

[B] Entire series, effect on correlation ( .564) is:

Lower 2006> -.029 1996< -.017 1962> -.017 1987> -.017 2015> -.010 1973< -.010 Higher 2010 .018 1966 .018

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

2006 +3.1 SD

600B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1926 122 128 170 150

1930 153 157 144 84 120 138 71 51 176 114

1940 117 102 89 97 62 44 53 154 85 188

1950 215 322 260 202 214 198 162 210 246 227

1960 284 311 296 244 324 344 151 248 201 172

1970 357 200 222 153 64 95 149 229 224 146

1980 283 218 176 167 147 118 115 161 139 133

1990 100 68 83 128 82 47 35 60 47 52

2000 55 41 47 39 82 45 106 75 53 78

2010 30 45 43 48 125 86

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1071A 1899 to 2015 117 years Series 10

[\*] Early part of series cannot be checked from 1899 to 1907 -- not matched by another series

[B] Entire series, effect on correlation ( .531) is:

Lower 1945> -.028 1975> -.019 2006< -.018 1949< -.017 1910< -.012 1972< -.012 Higher 1948 .106 2014 .017

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

1949 1950 4.1 SD

[D] 1 Absent rings: Year Master N series Absent

2006 -.762 26 1

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

1949 -6.5 SD; 2006 -5.0 SD

1071A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1899 42

1900 73 79 109 74 76 81 72 70 70 52

1910 38 32 31 29 35 34 46 43 47 133

1920 326 300 290 246 361 314 294 326 283 274

1930 132 93 226 173 172 163 124 139 198 193

1940 128 139 121 154 150 154 117 127 60 55

1950 122 156 129 94 111 139 139 110 120 140

1960 146 116 119 125 165 150 118 149 146 145

1970 147 112 94 120 143 170 141 209 215 178

1980 204 232 154 130 98 96 68 47 71 46

1990 50 71 106 97 133 107 111 70 40 51

2000 79 71 76 70 94 62 0 39 41 55

2010 22 30 62 34 97 46

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1071B 1911 to 2015 105 years Series 11

[B] Entire series, effect on correlation ( .518) is:

Lower 1930< -.035 1936> -.031 1911> -.019 1939< -.017 1945> -.016 1961< -.013 Higher 1948 .066 2014 .015

1071B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1911 25 34 28 29 39 55 36 37 141

1920 344 256 253 238 408 358 343 377 310 295

1930 121 134 164 183 218 189 168 124 156 102

1940 111 75 123 141 162 146 103 107 52 95

1950 93 185 223 182 199 183 164 166 169 152

1960 159 107 105 124 167 193 157 190 142 131

1970 148 98 141 144 120 101 77 126 137 108

1980 118 169 176 183 134 85 58 41 44 48

1990 78 92 122 76 148 72 68 58 29 48

2000 57 43 79 53 46 53 32 35 29 53

2010 30 58 55 32 77 41

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1072A 1944 to 2015 72 years Series 12

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

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

1950 1999 -1 -.08 -.06 -.14 -.13 .05 -.15 -.08 -.01 .02 .42\* .38|-.11 -.03 .01 -.08 -.05 -.14 -.32 -.04 -.03 .20

[B] Entire series, effect on correlation ( .564) is:

Lower 1998> -.023 1987< -.021 1969< -.019 1965< -.012 2006> -.012 1960> -.011 Higher 2010 .063 1948 .020

1950 to 1999 segment:

Lower 1998> -.046 1969< -.025 1960> -.022 1965< -.022 1996> -.018 1962> -.017 Higher 1975 .055 1986 .051

1072A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1944 94 57 86 120 55 199

1950 137 183 185 198 132 175 164 139 167 155

1960 178 148 138 87 111 85 83 88 112 57

1970 164 106 99 102 98 62 66 129 198 130

1980 154 117 172 169 210 157 109 78 128 178

1990 191 187 210 216 244 233 300 230 290 241

2000 247 197 211 235 238 149 229 197 192 218

2010 50 149 218 129 184 83

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1072B 1941 to 2015 75 years Series 13

[B] Entire series, effect on correlation ( .617) is:

Lower 1964< -.030 1969< -.021 2014< -.018 1998> -.016 1974> -.015 1985> -.015 Higher 1948 .133 2010 .032

1072B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1941 72 95 95 75 47 88 128 53 125

1950 140 173 201 160 111 115 119 105 116 136

1960 86 102 93 109 85 211 127 146 92 45

1970 117 134 168 202 153 64 61 128 166 131

1980 123 77 101 114 183 213 97 88 96 95

1990 95 122 114 133 175 137 145 140 143 103

2000 118 103 105 136 163 102 115 85 157 132

2010 46 83 187 136 96 50

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1073A 1908 to 2015 108 years Series 14

[B] Entire series, effect on correlation ( .696) is:

Lower 1910> -.012 2006> -.012 1958< -.009 1909> -.009 2003> -.009 1949< -.009 Higher 1948 .046 2010 .018

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

1936 -6.8 SD

1073A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1908 60 79

1910 83 42 28 38 37 31 24 20 11 100

1920 277 220 263 146 155 140 154 146 143 150

1930 150 139 144 136 128 115 58 79 128 150

1940 141 119 119 145 160 92 84 166 62 74

1950 160 246 283 250 235 255 225 223 163 132

1960 159 221 174 238 209 195 148 238 238 289

1970 265 218 248 296 191 142 139 194 225 183

1980 253 175 225 160 217 185 125 79 98 107

1990 100 118 142 181 192 196 148 98 90 112

2000 136 131 152 216 221 194 211 229 209 166

2010 41 96 104 119 195 116

====================================================================================================================================

1073B 1930 to 2015 86 years Series 15

[B] Entire series, effect on correlation ( .688) is:

Lower 2006> -.036 1965< -.020 1996< -.013 1956< -.011 1930> -.010 2004< -.005 Higher 2010 .034 1936 .033

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

1936 -5.0 SD; 2006 +3.3 SD

1073B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1930 254 266 212 185 188 204 65 147 248 210

1940 214 198 239 252 259 127 130 281 139 177

1950 224 248 355 287 236 268 191 257 316 223

1960 258 233 199 224 265 202 198 251 210 242

1970 324 271 254 318 219 173 146 206 307 259

1980 319 260 290 198 215 142 108 85 117 132

1990 118 104 132 134 126 92 52 52 59 60

2000 101 92 92 101 106 112 211 174 121 140

2010 18 123 108 87 163 91

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1075A 1936 to 2015 80 years Series 16

[B] Entire series, effect on correlation ( .580) is:

Lower 1945> -.034 2010> -.030 1951< -.027 1996< -.017 1984< -.010 2001> -.010 Higher 1948 .111 1936 .036

1075A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1936 255 436 529 448

1940 489 507 673 526 477 482 326 364 199 329

1950 324 270 286 335 322 348 251 269 346 252

1960 199 261 150 231 250 241 175 178 121 249

1970 234 155 147 198 92 125 115 215 182 133

1980 133 131 166 123 76 77 85 78 111 103

1990 117 73 72 80 98 76 48 75 86 99

2000 120 119 162 106 200 117 31 50 84 167

2010 115 71 107 139 195 84

====================================================================================================================================

1075B 1975 to 2015 41 years Series 17

[B] Entire series, effect on correlation ( .496) is:

Lower 1991< -.042 1998> -.022 2006< -.020 1986> -.017 1989> -.012 2001> -.011 Higher 2015 .034 2014 .033

1075B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1975 144 191 172 289 280

1980 437 411 334 181 144 140 159 127 208 230

1990 241 97 99 121 150 104 93 105 145 148

2000 150 144 245 184 270 172 75 84 124 270

2010 158 174 195 173 278 140

====================================================================================================================================

1154A 1955 to 2015 61 years Series 18

[B] Entire series, effect on correlation ( .433) is:

Lower 1963< -.172 1962> -.036 1974> -.015 1978< -.013 2006> -.012 2003> -.012 Higher 2010 .053 1970 .018

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

1962 1963 -4.7 SD

1154A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1955 552 486 438 432 370

1960 304 328 377 219 292 281 246 301 252 281

1970 384 267 312 327 303 247 208 239 225 154

1980 222 351 368 338 276 256 181 182 204 199

1990 220 209 212 212 229 132 105 115 100 89

2000 88 92 93 139 173 110 122 145 144 146

2010 64 66 67 66 99 57

====================================================================================================================================

1154B 1925 to 2015 91 years Series 19

[B] Entire series, effect on correlation ( .555) is:

Lower 1938< -.050 1936> -.020 1926> -.015 1962> -.014 1942< -.013 1967< -.013 Higher 1948 .101 2010 .022

1154B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1925 199 259 190 173 227

1930 168 176 217 173 203 235 175 120 80 164

1940 152 151 123 217 245 227 212 209 81 416

1950 322 459 449 430 356 306 320 350 305 274

1960 259 237 290 321 338 342 219 202 181 228

1970 248 254 268 317 292 244 267 325 424 404

1980 487 441 450 353 320 333 276 308 301 335

1990 365 419 362 387 337 249 267 201 210 279

2000 276 177 190 284 324 269 164 206 259 266

2010 157 138 182 195 233 145

====================================================================================================================================

1155A 1920 to 2015 96 years Series 20

[B] Entire series, effect on correlation ( .584) is:

Lower 1940< -.015 1930> -.015 2006> -.013 1927< -.011 1993< -.010 1966> -.008 Higher 1936 .056 1920 .012

1155A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1920 334 203 219 211 165 169 227 165 257 208

1930 258 230 187 195 228 230 128 158 192 173

1940 127 149 164 172 183 137 142 211 138 168

1950 183 223 260 245 256 230 209 242 200 134

1960 118 140 129 171 214 188 161 166 154 146

1970 153 123 163 154 143 133 147 142 204 154

1980 180 169 207 150 143 108 85 111 142 103

1990 129 107 112 94 123 108 83 97 98 75

2000 77 64 86 91 91 93 113 107 122 166

2010 80 58 100 55 94 63

====================================================================================================================================

1155B 1921 to 2015 95 years Series 21

[B] Entire series, effect on correlation ( .562) is:

Lower 1948> -.041 1973< -.025 1950< -.024 2010> -.021 1923< -.016 1967< -.009 Higher 1936 .059 1945 .020

1155B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1921 165 271 157 159 145 174 172 199 156

1930 148 165 187 156 160 219 118 114 155 209

1940 164 115 152 153 141 92 95 185 126 136

1950 95 155 155 138 117 128 146 131 153 134

1960 104 83 68 80 91 109 75 76 92 94

1970 129 96 109 78 90 85 92 111 141 124

1980 155 156 212 153 104 93 99 133 142 121

1990 148 187 204 175 215 151 192 141 116 107

2000 140 86 102 113 159 138 114 121 174 204

2010 112 79 65 35 91 61

====================================================================================================================================

1173A 1946 to 2015 70 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

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

1946 1995 0 -.11 .14 -.03 -.05 .07 -.01 -.10 -.01 -.01 -.13 .29\* .21 .00 -.12 .12 -.02 .12 .04 -.24 -.08 -.12

1966 2015 -5 -.04 -.04 .09 -.10 .16 .24\* .04 -.04 .05 -.39 .24| - - - - - - - - - -

[B] Entire series, effect on correlation ( .283) is:

Lower 1986> -.045 2010> -.024 1947< -.019 1987> -.017 1976> -.014 2003< -.013 Higher 1962 .027 2015 .021

1946 to 1995 segment:

Lower 1986> -.068 1947< -.029 1987> -.025 1976> -.021 1948> -.015 1960> -.015 Higher 1962 .042 1974 .029

1966 to 2015 segment:

Lower 1986> -.072 2010> -.041 1987> -.027 1976> -.023 2006> -.019 1981< -.013 Higher 2015 .033 1974 .030

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

1986 +3.2 SD; 1987 +3.4 SD

1173A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1946 71 19 13 63

1950 184 264 238 289 291 205 216 122 220 158

1960 209 194 79 138 204 143 100 92 54 27

1970 58 32 30 47 19 30 100 145 139 148

1980 206 157 233 255 294 247 445 483 473 391

1990 421 272 308 429 403 297 324 274 256 251

2000 267 189 206 134 193 147 212 161 196 185

2010 196 366 431 383 337 154

====================================================================================================================================

1173B 1952 to 2015 64 years Series 23

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

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

1966 2015 -9 .23 .37\* .07 .09 -.17 .36 -.09 -.22 -.09 -.35 .36| - - - - - - - - - -

[B] Entire series, effect on correlation ( .433) is:

Lower 1994< -.032 1998> -.030 1973< -.019 2010> -.014 1955< -.014 1989> -.014 Higher 2015 .028 1966 .024

1966 to 2015 segment:

Lower 1994< -.035 1998> -.034 1973< -.022 1989> -.015 2010> -.014 1987> -.013 Higher 2015 .033 1966 .029

[D] 2 Absent rings: Year Master N series Absent

1974 -.793 25 1

2001 -.900 26 1

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

2001 -5.7 SD

1173B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1952 345 341 272 186 183 154 215 130

1960 122 99 53 66 85 88 33 55 28 21

1970 40 23 33 19 0 12 25 148 143 142

1980 112 268 262 231 155 183 197 253 325 410

1990 349 198 254 252 165 171 201 296 437 430

2000 328 0 442 358 349 287 236 193 165 210

2010 170 249 220 229 266 120

====================================================================================================================================

1177A 1928 to 2015 88 years Series 24

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

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

1950 1999 0 -.15 .17 -.10 .09 -.02 -.15 .18 -.13 -.14 .18 .32\* .11 -.20 -.10 -.13 .00 -.09 -.26 .09 .12 .04

1966 2015 0 -.16 .08 -.10 .03 .07 -.16 .12 .06 -.12 .02 .31\* - - - - - - - - - -

[B] Entire series, effect on correlation ( .399) is:

Lower 2004< -.024 1980< -.019 2015> -.017 1955< -.012 1990< -.012 1986> -.011 Higher 2010 .068 1975 .021

1950 to 1999 segment:

Lower 1980< -.040 1986> -.026 1955< -.023 1971> -.019 1990< -.018 1991> -.017 Higher 1975 .134 1966 .058

1966 to 2015 segment:

Lower 2004< -.043 1980< -.033 2015> -.032 1986> -.022 1990< -.018 1971> -.015 Higher 2010 .119 1975 .054

[D] 1 Absent rings: Year Master N series Absent

2010 -2.235 26 1

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

1990 -4.8 SD

1177A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1928 213 268

1930 183 187 171 103 79 40 26 26 25 10

1940 16 3 11 23 3 8 4 172 59 213

1950 329 406 315 237 234 145 203 219 325 357

1960 339 285 269 191 221 227 166 232 228 296

1970 250 256 250 318 249 134 112 174 161 167

1980 123 106 105 87 91 88 90 78 75 53

1990 40 73 92 89 93 95 89 67 56 61

2000 83 56 50 34 22 34 18 19 26 24

2010 0 43 37 16 26 29

====================================================================================================================================

1177B 1935 to 2015 81 years Series 25

[B] Entire series, effect on correlation ( .309) is:

Lower 1990< -.079 1936> -.056 1948> -.013 2002< -.013 1943< -.010 2001> -.010 Higher 2014 .030 1966 .025

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

1990 1991 5.3 SD

[D] 1 Absent rings: Year Master N series Absent

1990 .084 26 1 >> WARNING: Ring is not usually narrow

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

1936 +3.8 SD; 1990 -7.5 SD

1177B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1935 100 92 57 44 34

1940 45 16 26 7 4 13 5 61 58 119

1950 236 187 166 142 156 188 283 203 217 172

1960 202 174 172 196 227 231 153 224 171 192

1970 168 135 170 161 93 56 34 86 105 107

1980 102 122 165 127 147 102 80 71 57 35

1990 0 65 50 49 49 69 45 60 56 50

2000 72 60 31 34 40 29 20 27 22 43

2010 28 18 22 29 57 20

====================================================================================================================================

597B 1952 to 2015 64 years Series 26

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

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

1952 2001 0 .01 -.18 -.06 -.25 -.16 .07 -.17 .08 .02 .03 .27\*-.05 -.03 .07 -.07 .22 .09 -.26 -.05 .05 .23

[B] Entire series, effect on correlation ( .442) is:

Lower 1975> -.041 2000< -.040 1958< -.025 1981< -.023 2009< -.022 1985> -.020 Higher 2010 .141 1986 .025

1952 to 2001 segment:

Lower 1975> -.057 2000< -.054 1958< -.036 1981< -.031 1985> -.028 1977< -.025 Higher 1986 .055 1978 .032

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

2010 -4.8 SD

597B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1952 97 116 195 223 83 100 76 108

1960 65 104 159 205 244 224 119 179 197 177

1970 180 136 204 243 191 205 201 155 253 233

1980 216 129 183 198 165 278 141 108 195 215

1990 163 156 133 224 233 188 149 150 157 167

2000 84 105 176 172 264 170 130 153 160 108

2010 22 169 142 174 257 131

====================================================================================================================================

PART 7: DESCRIPTIVE STATISTICS: MMRB1400B\_BEAL\_Corr4-50 14:11 Mon 31 Jul 2017 Page 6

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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 103A 1929 2015 87 3 0 .626 1.47 3.47 .865 .882 .263 2.50 .384 -.093 1

2 103B 1941 2015 75 3 0 .631 2.06 4.73 1.071 .822 .286 2.52 .419 -.013 1

3 597A 1952 2015 64 2 0 .541 1.62 3.33 .668 .675 .261 2.54 .430 .036 1

4 598A 1923 2015 93 4 0 .497 1.43 2.66 .660 .810 .283 2.46 .338 .035 1

5 598B 1934 2015 82 3 0 .517 1.47 3.73 .781 .797 .291 2.66 .347 -.045 1

6 599A 1923 2015 93 4 2 .414 1.18 2.91 .584 .665 .344 2.66 .456 -.060 1

7 599B 1930 2015 86 3 0 .595 1.42 2.73 .706 .864 .301 2.78 .532 .032 1

8 600A 1925 2015 91 3 0 .545 .90 2.13 .387 .498 .351 2.66 .456 -.040 1

9 600B 1926 2015 90 3 0 .564 1.42 3.57 .818 .753 .320 2.68 .518 .086 1

10 1071A 1899 2015 117 4 0 .531 1.21 3.61 .745 .851 .273 2.59 .363 .036 2

11 1071B 1911 2015 105 4 0 .518 1.27 4.08 .829 .847 .277 2.82 .531 -.044 1

12 1072A 1944 2015 72 3 1 .564 1.56 3.00 .595 .597 .295 2.53 .434 .051 2

13 1072B 1941 2015 75 3 0 .617 1.18 2.13 .391 .329 .305 2.56 .392 -.082 3

14 1073A 1908 2015 108 4 0 .696 1.54 2.96 .673 .749 .255 2.42 .317 .028 3

15 1073B 1930 2015 86 3 0 .688 1.86 3.55 .769 .707 .267 2.56 .373 -.014 1

16 1075A 1936 2015 80 3 0 .580 2.06 6.73 1.378 .880 .281 2.56 .438 -.003 1

17 1075B 1975 2015 41 1 0 .496 1.85 4.37 .830 .610 .284 2.66 .587 .077 1

18 1154A 1955 2015 61 2 0 .433 2.24 5.52 1.140 .895 .174 2.48 .376 -.075 1

19 1154B 1925 2015 91 3 0 .555 2.66 4.87 .907 .745 .195 2.67 .459 .032 1

20 1155A 1920 2015 96 4 0 .584 1.55 3.34 .549 .754 .194 2.67 .460 -.034 1

21 1155B 1921 2015 95 4 0 .562 1.33 2.71 .417 .576 .222 2.70 .492 .049 1

22 1173A 1946 2015 70 3 2 .283 2.07 4.83 1.216 .844 .338 2.72 .577 -.136 1

23 1173B 1952 2015 64 2 1 .433 1.88 4.42 1.187 .699 .407 2.52 .385 -.064 1

24 1177A 1928 2015 88 3 2 .399 1.28 4.06 1.045 .892 .369 2.67 .405 .026 1

25 1177B 1935 2015 81 3 0 .309 .96 2.83 .707 .880 .378 2.57 .396 .017 1

26 597B 1952 2015 64 2 1 .442 1.66 2.78 .531 .330 .317 2.60 .430 -.006 2

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Total or mean: 2155 79 9 .530 1.55 6.73 .773 .737 .288 2.82 .431 -.007

- = [ COFECHA BEAL COF ] = -