[] Dendrochronology Program Library Run VMC91 Program COF 15:27 Mon 13 Mar 2017 Page 1

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[] P R O G R A M C O F E C H A Version 6.06P 30024

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QUALITY CONTROL AND DATING CHECK OF TREE-RING MEASUREMENTS

Title of run: VMC919\_ACSA\_Corr4\_Final

File of DATED series: VMC919\_ACSA\_Corr4\_Final

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 1879 to 2015 137 years

Continuous time span is 1879 to 2015 137 years

Portion with two or more series is 1893 to 2015 123 years

>> 1237B 1922 absent in 1 of 9 series, but is not usually narrow: master index is .875

>> 1240B 1999 absent in 1 of 30 series, but is not usually narrow: master index is .636

>> 1240B 2002 absent in 1 of 30 series, but is not usually narrow: master index is .114

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

\*C\* Number of dated series 30 \*C\*

\*O\* Master series 1879 2015 137 yrs \*O\*

\*F\* Total rings in all series 2547 \*F\*

\*E\* Total dated rings checked 2533 \*E\*

\*C\* Series intercorrelation .554 \*C\*

\*H\* Average mean sensitivity .299 \*H\*

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

\*\*\* Mean length of series 84.9 \*\*\*

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

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

1233B 1 absent rings: 1929

1237A 2 absent rings: 1929 1946

1237B 1 absent rings: 1922

1238B 1 absent rings: 2001

1240B 4 absent rings: 1925 1999 2001 2002

1234A 1 absent rings: 2000

10 absent rings .393%

PART 2: TIME PLOT OF TREE-RING SERIES: VMC919\_ACSA\_Corr4\_Final 15:27 Mon 13 Mar 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

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

. . . . . . . . . . . . . . . . . . <=====> . 1006A 1 1953 2015 63

. . . . . . . . . . . . . . . . . . <======> . 1006B 2 1942 2015 74

. . . . . . . . . . . . . . . . . . <=======> . 1226A 3 1939 2015 77

. . . . . . . . . . . . . . . . . . <=======> . 1226B 4 1931 2015 85

. . . . . . . . . . . . . . . . . . <=====> . 1227A 5 1956 2015 60

. . . . . . . . . . . . . . . . . . <======> . 1227B 6 1947 2015 69

. . . . . . . . . . . . . . . . . . <=====> . 1228A 7 1950 2015 66

. . . . . . . . . . . . . . . . . . <=====> . 1228B 8 1950 2015 66

. . . . . . . . . . . . . . . . . . <=====> . 1229A 9 1952 2015 64

. . . . . . . . . . . . . . . . . . <======> . 1229B 10 1948 2015 68

. . . . . . . . . . . . . . . . . . <=======> . 1230A 11 1934 2015 82

. . . . . . . . . . . . . . . . . . <========> . 1230B 12 1928 2015 88

. . . . . . . . . . . . . . . . . . <========> . 1231A 13 1920 2015 96

. . . . . . . . . . . . . . . . . .<=========> . 1231B 14 1916 2015 100

. . . . . . . . . . . . . . . . . . <=======> . 1232A 15 1939 2015 77

. . . . . . . . . . . . . . . . . . <======> . 1232B 16 1940 2015 76

. . . . . . . . . . . . . . . . . . <=======> . 1233A 17 1936 2015 80

. . . . . . . . . . . . . . . . . . <========> . 1233B 18 1922 2015 94

. . . . . . . . . . . . . . . . . . <========> . 1235A 19 1925 2015 91

. . . . . . . . . . . . . . . . . . <========> . 1235B 20 1925 2015 91

. . . . . . . . . . . . . . . . . <==========> . 1237A 21 1900 2015 116

. . . . . . . . . . . . . . . . . <==========> . 1237B 22 1908 2015 108

. . . . . . . . . . . . . . . . . <=============> . 1238A 23 1879 2015 137

. . . . . . . . . . . . . . . . . <===========> . 1238B 24 1893 2015 123

. . . . . . . . . . . . . . . . . . <=======> . 1239A 25 1936 2015 80

. . . . . . . . . . . . . . . . . . <=======> . 1239B 26 1936 2015 80

. . . . . . . . . . . . . . . . . .<=========> . 1240A 27 1916 2015 100

. . . . . . . . . . . . . . . . . .<=========> . 1240B 28 1919 2015 97

. . . . . . . . . . . . . . . . . . <======> . 1234A 29 1945 2015 71

. . . . . . . . . . . . . . . . . . <======> . 1234B 30 1948 2015 68

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

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: VMC919\_ACSA\_Corr4\_Final 15:27 Mon 13 Mar 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 -.304 3 1950 -.518 27 2000 -1.197 30 1

1901 .301 3 1951 .439 27 2001 -1.226 30 2

1902 .431 3 1952 -.091 28 2002 .114 30 1<<

1903 1.547 3 1953 -1.328 29 2003 -.832 30

1904 -3.032 3 1954 -.327 29 2004 .185 30

1905 -3.949 3 1955 1.587 29 2005 .986 30

1906 -.575 3 1956 .212 30 2006 .198 30

1907 -.100 3 1957 .884 30 2007 -.237 30

1908 .454 4 1958 .791 30 2008 1.239 30

1909 1.313 4 1959 .306 30 2009 1.310 30

1910 1.032 4 1960 .183 30 2010 1.274 30

1911 .804 4 1961 1.069 30 2011 .134 30

1912 -.422 4 1962 -1.214 30 2012 -.656 30

1913 -1.357 4 1963 .247 30 2013 -.805 30

1914 1.509 4 1964 -.093 30 2014 -1.144 30

1915 1.837 4 1965 -1.621 30 2015 -.325 30

1916 .620 6 1966 -.292 30

1917 .526 6 1967 .535 30

1918 .579 6 1968 .150 30

1919 .599 7 1969 .734 30

1920 .835 8 1970 -.059 30

1921 .666 8 1971 -.418 30

1922 .875 9 1<< 1972 -.072 30

1923 -.123 9 1973 .384 30

1924 .094 9 1974 -.753 30

1925 -.782 11 1 1975 .075 30

1926 -.502 11 1976 -.164 30

1927 -.337 11 1977 -.885 30

1928 -.217 12 1978 1.176 30

1879 1.038 1 1929 -.919 12 2 1979 -.102 30

1880 1.213 1 1930 -.636 12 1980 .988 30

1881 1.364 1 1931 -.193 13 1981 -.187 30

1882 -.073 1 1932 -1.248 13 1982 .555 30

1883 -.618 1 1933 -.799 13 1983 .076 30

1884 -.847 1 1934 -.072 14 1984 .401 30

1885 -.404 1 1935 .617 14 1985 .644 30

1886 2.380 1 1936 1.316 17 1986 .345 30

1887 .564 1 1937 .547 17 1987 -.131 30

1888 -3.421 1 1938 -.091 17 1988 -3.224 30

1889 -2.386 1 1939 .635 19 1989 -1.664 30

1890 -1.011 1 1940 .018 20 1990 .141 30

1891 -.322 1 1941 .202 20 1991 -.015 30

1892 -.400 1 1942 .238 21 1992 .521 30

1893 .173 2 1943 .684 21 1993 .276 30

1894 -.767 2 1944 -.385 21 1994 1.318 30

1895 .906 2 1945 -.252 22 1995 -.729 30

1896 1.304 2 1946 -1.421 22 1 1996 .088 30

1897 .904 2 1947 .422 23 1997 -.534 30

1898 .567 2 1948 -.280 25 1998 1.347 30

1899 -.867 2 1949 -.701 25 1999 .636 30 1<<

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PART 4: Master Bar Plot: VMC919\_ACSA\_Corr4\_Final 15:27 Mon 13 Mar 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---a 1950--b 2000-e

1901------A 1951-------B 2001-e

1902-------B 1952----@ 2002-----@

1903----------F 1953e 2003-c

1904l 1954---a 2004------A

1905p 1955----------F 2005---------D

1906--b 1956------A 2006------A

1907----@ 1957---------D 2007---a

1908-------B 1958--------C 2008----------E

1909----------E 1959------A 2009----------E

1910---------D 1960------A 2010----------E

1911--------C 1961---------D 2011-----A

1912---b 1962-e 2012--c

1913e 1963------A 2013-c

1914----------F 1964----@ 2014-e

1915----------G 1965f 2015---a

1916--------B 1966---a

1917-------B 1967-------B

1918-------B 1968-----A

1919--------B 1969--------C

1920--------C 1970----@

1921--------C 1971---b

1922---------D 1972----@

1923----@ 1973------B

1924-----@ 1974-c

1925-c 1975-----@

1926--b 1976----a

1927---a 1977-d

1928---a 1978---------E

1879---------D 1929-d 1979----@

1880----------E 1930--c 1980---------D

1881----------E 1931----a 1981----a

1882----@ 1932e 1982-------B

1883--b 1933-c 1983-----@

1884-c 1934----@ 1984-------B

1885---b 1935--------B 1985--------C

1886----------J 1936----------E 1986------A

1887-------B 1937-------B 1987----a

1888n 1938----@ 1988m

1889j 1939--------C 1989g

1890-d 1940-----@ 1990-----A

1891---a 1941------A 1991----@

1892---b 1942------A 1992-------B

1893------A 1943--------C 1993------A

1894-c 1944---b 1994----------E

1895---------D 1945---a 1995-c

1896----------E 1946f 1996-----@

1897---------D 1947-------B 1997--b

1898-------B 1948---a 1998----------E

1899-c 1949--c 1999--------C

PART 5: CORRELATION OF SERIES BY SEGMENTS: VMC919\_ACSA\_Corr4\_Final 15:27 Mon 13 Mar 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 1006A 1953 2015 .61 .48

2 1006B 1942 2015 .60 .56 .53

3 1226A 1939 2015 .46 .45 .46

4 1226B 1931 2015 .38 .57 .70

5 1227A 1956 2015 .66 .66

6 1227B 1947 2015 .51 .55 .47

7 1228A 1950 2015 .37 .49

8 1228B 1950 2015 .65 .75

9 1229A 1952 2015 .51 .60

10 1229B 1948 2015 .51 .53 .61

11 1230A 1934 2015 .27A .53 .67

12 1230B 1928 2015 .26B .51 .67

13 1231A 1920 2015 .60 .62 .78 .77

14 1231B 1916 2015 .55 .61 .80 .74

15 1232A 1939 2015 .42 .52 .46

16 1232B 1940 2015 .43 .58 .54

17 1233A 1936 2015 .48 .67 .58

18 1233B 1922 2015 .50 .51 .53 .39

19 1235A 1925 2015 .33 .63 .69

20 1235B 1925 2015 .40 .74 .73

21 1237A 1900 2015 .42 .54 .57 .59

22 1237B 1908 2015 .59 .50 .49 .63

23 1238A 1879 2015 .69 .72 .54 .68 .62

24 1238B 1893 2015 .73 .69 .57 .72 .65

25 1239A 1936 2015 .43 .45 .46

26 1239B 1936 2015 .70 .78 .50

27 1240A 1916 2015 .54 .63 .79 .67

28 1240B 1919 2015 .60 .63 .72 .65

29 1234A 1945 2015 .35 .29A .17B

30 1234B 1948 2015 .43 .44 .42

Av segment correlation .71 .58 .48 .59 .58

PART 6: POTENTIAL PROBLEMS: VMC919\_ACSA\_Corr4\_Final 15:27 Mon 13 Mar 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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1006A 1953 to 2015 63 years Series 1

[B] Entire series, effect on correlation ( .514) is:

Lower 1980< -.062 1967< -.024 2013> -.022 2009< -.021 2014> -.020 1989> -.015 Higher 1988 .125 2000 .041

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

2013 +3.0 SD

1006A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1953 115 159 307 280 367 287 242

1960 287 204 152 183 209 157 139 145 180 172

1970 210 186 270 218 200 344 228 213 274 248

1980 188 235 344 354 405 291 296 312 188 315

1990 326 328 263 291 308 183 252 221 284 220

2000 134 163 267 144 166 179 114 108 143 116

2010 124 125 115 143 128 125

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

1006B 1942 to 2015 74 years Series 2

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

Lower 1995> -.020 2001> -.020 2014> -.013 1986< -.012 1979> -.012 1944> -.012 Higher 1988 .032 2000 .029

1006B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1942 151 141 165 134 107 245 203 205

1950 135 186 180 91 179 276 240 273 204 182

1960 211 185 126 152 234 156 138 176 172 207

1970 191 159 200 179 169 419 346 260 455 472

1980 519 374 418 433 403 368 162 227 103 177

1990 230 134 172 176 244 243 223 240 259 338

2000 107 248 276 195 240 255 158 116 220 195

2010 193 127 112 136 147 139

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1226A 1939 to 2015 77 years Series 3

[B] Entire series, effect on correlation ( .452) is:

Lower 1995> -.024 1962> -.024 1944< -.017 1990< -.016 2004< -.015 1963< -.014 Higher 1953 .023 1988 .017

1226A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1939 129

1940 130 130 110 155 75 143 103 167 160 125

1950 158 149 137 104 218 205 159 162 213 156

1960 174 195 177 142 179 160 155 234 151 217

1970 198 198 115 192 130 126 177 111 165 149

1980 213 144 196 166 167 175 237 144 125 119

1990 137 157 234 161 246 197 198 171 211 208

2000 148 128 183 142 130 220 198 224 201 188

2010 223 148 157 73 121 78

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1226B 1931 to 2015 85 years Series 4

[B] Entire series, effect on correlation ( .524) is:

Lower 1932> -.042 1995> -.028 1963< -.024 1962> -.022 1944< -.020 1938> -.011 Higher 1988 .071 2000 .029

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

1932 +4.2 SD

1226B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1931 117 146 116 100 105 133 88 122 139

1940 110 103 89 140 74 96 106 199 180 155

1950 196 207 149 134 243 236 232 306 329 246

1960 275 310 269 182 199 193 298 309 204 256

1970 224 224 178 204 130 169 209 138 270 234

1980 234 152 186 181 224 259 240 183 107 147

1990 166 157 225 245 309 303 205 232 272 250

2000 132 150 247 199 359 385 330 324 406 346

2010 247 192 153 111 123 92

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1227A 1956 to 2015 60 years Series 5

[B] Entire series, effect on correlation ( .629) is:

Lower 2008< -.030 1980< -.027 2005< -.020 1959< -.016 1956> -.016 1958< -.012 Higher 1988 .100 1962 .020

1227A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1956 155 120 103 88

1960 133 184 115 146 217 141 211 261 250 343

1970 267 260 294 325 223 239 240 224 318 211

1980 175 128 201 186 248 243 260 166 74 150

1990 255 141 149 132 173 68 139 134 225 151

2000 117 134 180 131 187 127 127 122 126 204

2010 206 191 169 159 119 203

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1227B 1947 to 2015 69 years Series 6

[B] Entire series, effect on correlation ( .522) is:

Lower 1995> -.029 2000> -.021 1974> -.018 2014< -.008 1971> -.008 1977< -.008 Higher 1998 .021 1955 .017

1227B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1947 94 88 111

1950 51 93 53 62 172 286 121 196 210 192

1960 246 339 203 243 303 203 296 272 314 375

1970 294 320 312 297 290 230 226 156 224 212

1980 219 146 211 204 244 278 244 159 131 213

1990 309 192 217 198 312 284 221 176 452 255

2000 202 88 130 109 216 194 138 145 221 188

2010 140 127 125 95 44 120

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1228A 1950 to 2015 66 years Series 7

[B] Entire series, effect on correlation ( .446) is:

Lower 1961< -.065 1991< -.039 1974> -.031 1993< -.021 1982< -.017 1970> -.015 Higher 1988 .064 1962 .029

1228A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1950 89 103 60 46 53 163 183 179 131 100

1960 95 63 66 170 212 198 175 237 314 300

1970 404 349 360 315 394 372 415 350 382 278

1980 328 268 235 231 352 350 331 229 185 235

1990 279 189 261 193 268 219 273 216 363 233

2000 188 185 222 213 213 206 180 185 284 297

2010 300 204 161 132 98 122

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

1228B 1950 to 2015 66 years Series 8

[B] Entire series, effect on correlation ( .669) is:

Lower 1999< -.031 1976> -.019 1960< -.018 1987< -.013 1961< -.013 1959< -.011 Higher 1988 .121 1978 .014

1228B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1950 91 102 47 26 61 123 160 217 171 91

1960 57 102 109 160 150 173 204 249 260 320

1970 291 328 293 342 324 300 423 349 485 395

1980 477 387 326 348 395 328 309 189 90 144

1990 205 205 220 168 242 136 136 124 184 88

2000 82 98 169 87 176 164 140 87 166 161

2010 136 126 78 75 50 73

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

1229A 1952 to 2015 64 years Series 9

[B] Entire series, effect on correlation ( .530) is:

Lower 1984< -.020 1962< -.018 1977> -.014 1955< -.013 1973< -.012 1953> -.012 Higher 1998 .018 1988 .018

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

1962 -7.2 SD

1229A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1952 486 359 292 307 227 431 241 214

1960 215 276 16 139 160 145 196 193 164 214

1970 209 196 156 119 139 183 167 168 162 107

1980 155 111 159 116 86 183 177 130 79 142

1990 207 176 194 181 168 79 143 128 254 194

2000 101 134 162 119 93 118 120 80 182 179

2010 142 63 57 96 74 92

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1229B 1948 to 2015 68 years Series 10

[B] Entire series, effect on correlation ( .533) is:

Lower 1953> -.052 1984< -.031 2005< -.027 1969< -.021 1983< -.020 1977> -.016 Higher 1988 .129 1962 .035

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

1953 +4.0 SD

1229B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1948 29 11

1950 21 47 128 182 95 166 89 109 78 60

1960 71 135 68 207 208 169 201 223 168 157

1970 203 232 235 230 231 273 218 241 268 178

1980 253 201 248 148 123 236 209 155 93 159

1990 208 206 198 195 207 130 145 133 205 188

2000 114 140 144 123 119 98 123 97 205 207

2010 202 104 116 129 123 117

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1230A 1934 to 2015 82 years Series 11

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

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

1934 1983 0 .17 -.02 .11 .21 .16 -.05 .13 -.06 -.13 -.42 .27\*-.10 -.10 .09 -.07 -.07 .11 .10 -.03 .13 -.08

[B] Entire series, effect on correlation ( .528) is:

Lower 1969< -.057 1937< -.042 1956< -.037 1965> -.018 1977> -.017 1939< -.012 Higher 1988 .100 2000 .022

1934 to 1983 segment:

Lower 1969< -.079 1937< -.040 1977> -.027 1965> -.025 1939< -.018 1956< -.017 Higher 1936 .032 1961 .029

1230A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1934 96 138 270 32 40 39

1940 66 143 123 210 147 195 173 248 290 289

1950 259 315 242 249 276 296 210 277 320 259

1960 279 409 269 301 339 296 260 266 303 106

1970 53 75 88 190 134 308 285 381 406 364

1980 457 316 420 358 285 292 290 233 123 191

1990 294 295 226 218 273 162 185 194 331 262

2000 140 153 163 170 279 327 183 236 281 338

2010 307 222 164 127 95 156

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1230B 1928 to 2015 88 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

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1928 1977 6 .15 -.01 .25 .05 .25 -.06 .03 .03 -.22 -.38 .26|-.18 -.20 .09 .00 -.17 .37\*-.04 .10 .18 -.22

[B] Entire series, effect on correlation ( .507) is:

Lower 1956< -.053 1995> -.024 1965> -.019 1937< -.018 1962> -.014 1973< -.013 Higher 1988 .100 2000 .019

1928 to 1977 segment:

Lower 1956< -.055 1965> -.032 1973< -.023 1937< -.022 1962> -.018 1944> -.014 Higher 1936 .039 1961 .032

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

1965 +3.1 SD

1230B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1928 45 34

1930 11 53 52 44 178 174 262 58 38 72

1940 121 136 172 229 237 240 203 291 245 283

1950 274 364 312 285 314 346 222 315 313 252

1960 269 417 336 442 452 366 293 325 285 276

1970 155 116 185 133 147 131 153 177 240 211

1980 263 155 248 246 228 209 218 188 92 128

1990 184 177 192 147 225 237 249 206 293 229

2000 133 133 158 136 235 234 154 192 195 184

2010 192 169 162 119 77 128

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1231A 1920 to 2015 96 years Series 13

[B] Entire series, effect on correlation ( .699) is:

Lower 2004< -.020 2000> -.015 1964< -.014 1952> -.010 1953> -.009 1948< -.008 Higher 1988 .074 1962 .017

1231A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1920 116 238 173 97 121 78 62 83 78 54

1930 69 156 135 172 171 230 339 226 126 143

1940 137 135 169 228 223 221 155 215 124 108

1950 193 341 419 321 350 350 354 381 370 322

1960 333 359 225 357 237 188 320 371 401 446

1970 306 259 314 397 313 303 320 239 324 186

1980 318 286 254 204 253 194 197 177 28 24

1990 59 84 115 133 143 47 117 71 123 71

2000 61 47 66 59 37 92 81 69 122 122

2010 126 92 85 87 88 90

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1231B 1916 to 2015 100 years Series 14

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

Lower 1925> -.014 1981> -.014 1941< -.014 1997< -.014 1917< -.013 2000> -.012 Higher 1988 .069 1962 .019

1231B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1916 73 57 84 64

1920 121 223 205 111 132 145 68 68 59 67

1930 134 158 136 83 134 233 326 240 137 111

1940 110 81 135 169 188 240 201 306 243 258

1950 287 352 378 324 349 457 401 477 395 353

1960 433 468 293 369 281 231 376 411 410 436

1970 293 322 352 365 282 265 335 206 426 257

1980 398 410 318 217 279 231 288 234 83 106

1990 170 213 231 208 248 97 163 77 178 146

2000 129 97 165 139 135 203 190 159 206 169

2010 173 134 151 131 129 122

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

1232A 1939 to 2015 77 years Series 15

[B] Entire series, effect on correlation ( .473) is:

Lower 2001> -.027 1988> -.022 1977> -.018 1946< -.018 1967< -.014 1962> -.012 Higher 1955 .016 2000 .014

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

1946 -4.9 SD; 2001 +3.2 SD

1232A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1939 228

1940 172 189 162 190 206 201 119 234 215 188

1950 191 235 201 164 211 375 321 346 371 332

1960 386 420 262 270 177 113 96 73 44 71

1970 71 99 107 120 133 214 163 233 252 218

1980 287 168 216 241 292 296 262 167 168 175

1990 274 212 212 234 263 209 265 237 273 277

2000 198 274 228 163 157 243 222 187 200 174

2010 164 132 99 90 88 89

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

1232B 1940 to 2015 76 years Series 16

[B] Entire series, effect on correlation ( .491) is:

Lower 2011< -.033 1962> -.030 1977> -.018 1948< -.017 2001> -.015 1944> -.015 Higher 2000 .036 1995 .022

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

1962 +3.0 SD

1232B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1940 173 152 139 175 209 217 147 183 115 185

1950 169 261 254 251 320 541 425 453 410 379

1960 452 545 454 397 257 205 171 158 146 174

1970 127 101 71 81 104 129 102 157 169 160

1980 217 133 163 215 195 184 129 101 74 101

1990 159 159 205 245 253 171 236 271 389 364

2000 235 291 295 257 281 373 253 253 299 239

2010 314 189 195 146 134 164

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

1233A 1936 to 2015 80 years Series 17

[B] Entire series, effect on correlation ( .543) is:

Lower 2003< -.037 1984< -.018 1936< -.017 1997> -.015 1945> -.014 1941< -.014 Higher 1988 .047 1978 .016

1233A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1936 102 149 158 162

1940 117 91 114 144 99 246 147 248 217 175

1950 160 236 220 142 142 298 194 190 214 256

1960 290 345 240 247 220 191 204 248 267 331

1970 241 229 297 323 259 387 229 234 405 290

1980 359 260 248 213 164 197 189 178 125 138

1990 194 157 175 217 206 128 133 185 174 142

2000 118 136 111 53 116 175 121 143 134 135

2010 121 84 59 58 58 93

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

1233B 1922 to 2015 94 years Series 18

[B] Entire series, effect on correlation ( .445) is:

Lower 1947< -.029 1995> -.018 2012> -.015 1948> -.015 2000> -.012 1976< -.011 Higher 1946 .020 1955 .020

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

1929 -.919 12 2

1233B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 275 119 97 21 80 73 31 0

1930 58 81 18 45 76 100 94 103 86 125

1940 131 148 164 227 141 252 59 49 424 315

1950 215 255 295 176 186 502 218 233 292 315

1960 231 277 183 237 209 184 297 242 283 337

1970 253 265 299 322 221 256 184 183 323 217

1980 293 314 313 273 289 366 472 502 234 293

1990 518 357 301 390 330 344 277 298 391 339

2000 264 268 247 129 182 337 249 219 278 313

2010 384 218 296 147 156 173

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

1235A 1925 to 2015 91 years Series 19

[B] Entire series, effect on correlation ( .568) is:

Lower 1980< -.029 1936< -.027 1935< -.020 1946> -.017 1987> -.012 1969< -.011 Higher 1988 .100 2000 .028

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

1928 +3.0 SD

1235A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1925 256 319 338 454 287

1930 283 355 190 127 137 106 111 199 132 201

1940 239 324 337 360 293 183 215 207 168 165

1950 147 197 264 120 119 305 166 197 289 235

1960 146 173 130 251 177 154 279 331 219 135

1970 192 106 111 96 81 93 60 64 89 82

1980 51 41 89 72 66 63 75 101 33 29

1990 32 53 69 73 78 48 94 56 92 104

2000 43 55 78 62 81 96 90 92 134 157

2010 141 97 31 60 52 62

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1235B 1925 to 2015 91 years Series 20

[B] Entire series, effect on correlation ( .604) is:

Lower 1946> -.036 1936< -.033 1987> -.019 1934< -.013 1925> -.011 1938< -.009 Higher 1988 .116 1955 .020

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

1946 +3.2 SD; 1987 +3.0 SD

1235B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1925 326 336 270 358 228

1930 312 365 156 171 118 143 124 191 85 188

1940 189 257 228 250 187 182 280 333 187 155

1950 150 169 191 143 189 548 335 311 320 284

1960 210 295 167 279 249 170 180 404 372 388

1970 420 259 286 555 362 367 269 252 413 338

1980 332 198 175 181 156 160 185 304 74 75

1990 139 135 121 127 146 98 109 58 97 124

2000 64 48 68 59 68 111 71 54 152 199

2010 195 109 48 65 63 44

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1237A 1900 to 2015 116 years Series 21

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

Lower 1904> -.044 1922< -.026 1974< -.023 1971< -.013 1923> -.010 1981> -.007 Higher 1988 .018 1914 .014

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

1929 -.919 12 2

1946 -1.421 22 1

1237A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1900 61 57 58 61 30 14 24 36 64 90

1910 59 78 41 41 130 88 66 86 51 60

1920 76 40 11 66 73 25 35 27 31 0

1930 38 28 41 88 176 215 302 165 208 335

1940 271 331 335 404 80 57 0 33 18 67

1950 91 105 121 104 136 285 268 263 300 296

1960 299 333 243 293 314 286 366 424 396 398

1970 295 198 234 335 189 258 258 223 303 213

1980 223 266 218 275 250 227 151 135 99 123

1990 252 203 243 181 197 121 142 117 213 168

2000 141 111 174 151 205 242 153 150 218 209

2010 187 148 156 105 106 101

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1237B 1908 to 2015 108 years Series 22

[B] Entire series, effect on correlation ( .551) is:

Lower 1922< -.036 1965> -.021 1980< -.020 1974< -.015 1923> -.011 1995> -.010 Higher 1988 .037 2000 .026

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

1922 .875 9 1 >> WARNING: Ring is not usually narrow

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

1922 -4.8 SD; 1965 +3.0 SD

1237B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1908 64 65

1910 74 68 35 20 90 95 55 86 53 44

1920 73 34 0 51 55 16 36 28 23 4

1930 39 33 59 118 206 249 286 207 235 347

1940 290 314 282 293 123 72 15 77 53 102

1950 117 165 147 123 135 207 216 223 309 331

1960 328 365 309 394 411 402 416 487 405 478

1970 374 285 329 396 223 350 270 245 332 258

1980 214 250 217 264 200 212 195 228 151 169

1990 311 272 310 235 292 263 223 289 468 370

2000 152 153 259 187 239 331 196 175 199 268

2010 330 172 124 140 109 134

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1238A 1879 to 2015 137 years Series 23

[\*] Early part of series cannot be checked from 1879 to 1892 -- not matched by another series

[B] Entire series, effect on correlation ( .675) is:

Lower 1893< -.016 1967< -.012 1937> -.010 1917< -.010 1905> -.009 2003> -.009 Higher 1904 .107 1988 .032

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

1904 1905 4.1 SD

1238A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1879 176

1880 178 179 131 114 106 114 203 136 59 74

1890 99 116 117 109 112 164 181 183 192 158

1900 153 220 188 249 93 133 198 204 218 263

1910 282 240 209 188 259 283 233 175 225 255

1920 231 163 187 127 155 160 142 186 163 137

1930 124 120 72 74 113 228 216 289 224 154

1940 72 99 176 181 148 145 145 216 152 105

1950 139 191 198 120 161 264 215 223 252 272

1960 189 228 155 165 145 92 89 93 108 144

1970 155 138 134 137 131 149 142 80 95 90

1980 145 113 124 84 87 70 74 106 49 55

1990 72 98 100 81 78 51 65 30 81 57

2000 46 26 76 103 126 109 68 70 92 103

2010 103 63 25 42 53 39

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1238B 1893 to 2015 123 years Series 24

[B] Entire series, effect on correlation ( .690) is:

Lower 1946> -.019 1893> -.015 1931< -.012 1901< -.012 1944> -.011 1918> -.009 Higher 1904 .101 2000 .010

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

2001 -1.226 30 2

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

1932 -4.6 SD

1238B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1893 220 147 210 237 205 177 131

1900 138 148 205 317 139 108 244 258 257 340

1910 294 280 278 217 291 396 358 279 385 323

1920 321 248 252 169 153 124 155 215 188 145

1930 73 24 4 35 70 122 130 100 82 115

1940 69 109 183 209 210 151 184 231 112 111

1950 113 163 169 126 233 405 286 308 262 223

1960 198 268 195 235 190 130 178 257 255 234

1970 166 181 180 168 122 143 127 105 141 135

1980 232 175 136 112 75 86 72 109 60 46

1990 56 63 57 57 76 52 46 20 73 137

2000 49 0 35 57 69 75 78 40 60 83

2010 74 52 19 30 37 21

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1239A 1936 to 2015 80 years Series 25

[B] Entire series, effect on correlation ( .415) is:

Lower 1957< -.043 1988> -.031 1938< -.026 1982< -.021 1996< -.013 1959> -.012 Higher 1955 .032 1965 .029

[E] Outliers 3 3.0 SD above or -4.5 SD below mean for year

1936 +3.8 SD; 1959 +3.1 SD; 1963 +3.1 SD

1239A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1936 56 23 3 25

1940 20 28 44 51 51 52 44 96 54 71

1950 93 169 115 101 184 294 244 228 268 363

1960 167 317 196 313 146 80 145 210 202 152

1970 97 110 166 180 96 92 110 87 229 137

1980 242 175 168 98 132 129 145 106 19 42

1990 84 94 106 141 186 81 157 136 212 137

2000 152 140 129 125 121 125 122 73 135 103

2010 77 83 71 54 58 92

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1239B 1936 to 2015 80 years Series 26

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

Lower 2010< -.087 2000> -.053 1962> -.015 2006> -.012 2002< -.011 1981> -.010 Higher 1988 .099 1965 .020

1239B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1936 28 11 4 22

1940 15 31 45 55 51 42 35 58 55 66

1950 106 153 106 71 145 299 188 195 264 354

1960 206 335 212 228 177 94 146 171 133 167

1970 108 195 180 176 127 145 120 98 193 126

1980 158 170 189 104 131 185 191 139 35 47

1990 92 104 130 153 210 83 160 104 121 108

2000 148 104 89 106 112 120 147 113 116 117

2010 67 92 75 62 61 78

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1240A 1916 to 2015 100 years Series 27

[B] Entire series, effect on correlation ( .621) is:

Lower 1943< -.020 2003> -.019 2001< -.018 1938> -.015 1964< -.013 1918< -.012 Higher 1988 .056 1965 .016

1240A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1916 104 157 87 86

1920 67 95 133 44 39 19 24 21 26 8

1930 25 39 30 80 127 184 223 211 293 281

1940 183 229 236 78 34 25 15 85 106 105

1950 93 113 89 91 125 158 158 159 158 141

1960 176 217 134 168 101 67 110 179 141 215

1970 155 133 134 196 149 237 265 235 298 231

1980 277 210 224 202 220 219 160 128 80 100

1990 169 141 153 169 176 106 119 116 143 106

2000 92 45 121 144 150 120 93 57 97 134

2010 131 95 67 93 45 57

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1240B 1919 to 2015 97 years Series 28

[B] Entire series, effect on correlation ( .608) is:

Lower 1943< -.030 1999< -.016 2003> -.016 1986< -.013 1938> -.012 2000> -.010 Higher 1988 .018 1965 .017

[D] 4 Absent rings: Year Master N series Absent

1925 -.782 11 1

1999 .636 30 1 >> WARNING: Ring is not usually narrow

2001 -1.226 30 2

2002 .114 30 1 >> WARNING: Ring is not usually narrow

1240B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1919 90

1920 74 86 121 72 50 0 15 18 11 4

1930 17 21 23 66 108 163 209 213 274 282

1940 206 219 256 61 53 34 31 97 88 113

1950 137 145 100 109 104 169 170 190 203 187

1960 175 199 104 164 159 115 176 215 165 242

1970 205 192 233 265 172 266 207 201 245 196

1980 234 167 190 142 181 191 95 100 31 35

1990 112 96 102 99 111 26 58 38 41 0

2000 14 0 0 39 52 68 66 58 90 103

2010 77 49 18 26 37 10

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

1234A 1945 to 2015 71 years Series 29

[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 .10 .07 .09 .01 -.12 -.03 -.12 -.06 -.02 .10 .29\* .00 .08 -.12 .01 -.17 .13 -.22 -.17 -.03 -.16

1966 2015 -1 .18 .03 .04 .00 -.13 -.12 -.18 -.17 .05 .21\* .17| - - - - - - - - - -

[B] Entire series, effect on correlation ( .364) is:

Lower 1975< -.136 1988> -.064 1998< -.028 1974> -.024 1996< -.016 1973< -.014 Higher 1955 .033 1965 .025

1950 to 1999 segment:

Lower 1975< -.154 1988> -.080 1998< -.033 1974> -.030 1996< -.017 1973< -.015 Higher 1955 .047 1965 .038

1966 to 2015 segment:

Lower 1975< -.153 1988> -.064 1998< -.033 1974> -.030 1996< -.017 1973< -.016 Higher 2000 .041 1994 .031

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

1974 1975 -5.6 SD

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

2000 -1.197 30 1

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

1975 -6.8 SD; 1988 +3.4 SD

1234A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1945 104 127 199 218 166

1950 158 222 225 160 206 407 301 404 364 359

1960 376 368 289 378 325 219 275 291 228 277

1970 212 180 166 102 184 13 40 33 108 84

1980 155 87 133 79 153 105 63 42 52 38

1990 36 68 114 73 124 53 20 29 13 35

2000 0 19 62 60 84 113 160 155 224 181

2010 239 205 164 95 124 112

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1234B 1948 to 2015 68 years Series 30

[B] Entire series, effect on correlation ( .508) is:

Lower 1990< -.061 1988> -.043 1975< -.021 1978< -.017 1993< -.014 1949< -.012 Higher 1962 .041 2000 .038

1234B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1948 234 166

1950 212 287 217 172 183 292 243 399 329 306

1960 302 339 142 170 201 160 241 341 345 360

1970 337 264 319 358 190 86 104 69 97 73

1980 133 88 121 98 167 119 76 104 70 81

1990 44 92 109 58 112 69 58 60 65 73

2000 46 47 68 62 87 100 132 90 140 114

2010 135 123 88 92 89 98

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PART 7: DESCRIPTIVE STATISTICS: VMC919\_ACSA\_Corr4\_Final 15:27 Mon 13 Mar 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 1006A 1953 2015 63 2 0 .514 2.20 4.05 .768 .646 .221 2.70 .556 .002 1

2 1006B 1942 2015 74 3 0 .562 2.19 5.19 .952 .670 .268 2.62 .447 -.061 1

3 1226A 1939 2015 77 3 0 .452 1.64 2.46 .397 .227 .247 2.51 .478 -.005 1

4 1226B 1931 2015 85 3 0 .524 2.02 4.06 .766 .737 .226 2.60 .487 -.003 1

5 1227A 1956 2015 60 2 0 .629 1.83 3.43 .630 .575 .275 2.58 .517 -.003 1

6 1227B 1947 2015 69 3 0 .522 2.03 4.52 .839 .589 .306 2.80 .536 -.003 1

7 1228A 1950 2015 66 2 0 .446 2.27 4.15 .957 .809 .218 2.97 .602 .023 1

8 1228B 1950 2015 66 2 0 .669 1.96 4.85 1.141 .873 .288 2.61 .423 .081 1

9 1229A 1952 2015 64 2 0 .530 1.68 4.86 .815 .584 .323 2.40 .338 -.015 1

10 1229B 1948 2015 68 3 0 .533 1.58 2.73 .626 .660 .286 2.58 .509 .003 1

11 1230A 1934 2015 82 3 1 .528 2.32 4.57 .954 .673 .286 2.65 .526 .014 1

12 1230B 1928 2015 88 3 1 .507 2.05 4.52 .927 .786 .264 2.49 .450 -.003 1

13 1231A 1920 2015 96 4 0 .699 1.92 4.46 1.117 .839 .284 2.61 .434 .028 1

14 1231B 1916 2015 100 4 0 .665 2.24 4.77 1.137 .804 .270 2.61 .479 -.049 1

15 1232A 1939 2015 77 3 0 .473 2.05 4.20 .789 .770 .202 2.70 .368 -.070 1

16 1232B 1940 2015 76 3 0 .491 2.26 5.45 1.088 .838 .216 2.68 .528 -.108 1

17 1233A 1936 2015 80 3 0 .543 1.90 4.05 .772 .690 .238 2.61 .421 .062 1

18 1233B 1922 2015 94 4 0 .445 2.32 5.18 1.133 .621 .367 2.67 .514 .100 2

19 1235A 1925 2015 91 3 0 .568 1.50 4.54 .956 .793 .301 2.57 .463 -.006 1

20 1235B 1925 2015 91 3 0 .604 2.08 5.55 1.136 .673 .301 2.71 .379 .016 1

21 1237A 1900 2015 116 4 0 .490 1.63 4.24 1.075 .841 .373 2.70 .406 -.011 1

22 1237B 1908 2015 108 4 0 .551 2.02 4.87 1.234 .855 .361 2.64 .415 -.030 1

23 1238A 1879 2015 137 5 0 .675 1.41 2.88 .628 .780 .245 2.44 .317 -.004 3

24 1238B 1893 2015 123 5 0 .690 1.57 4.05 .930 .835 .339 2.72 .357 .015 2

25 1239A 1936 2015 80 3 0 .415 1.27 3.63 .737 .649 .375 3.67 .498 -.055 2

26 1239B 1936 2015 80 3 0 .587 1.24 3.54 .700 .697 .338 3.02 .498 -.019 1

27 1240A 1916 2015 100 4 0 .621 1.31 2.98 .692 .799 .315 2.59 .502 .016 1

28 1240B 1919 2015 97 4 0 .608 1.16 2.82 .789 .843 .428 2.42 .389 -.040 2

29 1234A 1945 2015 71 3 2 .364 1.58 4.07 1.084 .854 .423 2.60 .390 .063 2

30 1234B 1948 2015 68 3 0 .508 1.59 3.99 .994 .836 .285 2.76 .619 -.046 1

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Total or mean: 2547 96 4 .554 1.81 5.55 .899 .738 .299 3.67 .453 -.004

- = [ COFECHA VMC91COF ] = -