[] Dendrochronology Program Library Run VMC59 Program COF 14:10 Fri 02 Sep 2016 Page 1

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[] P R O G R A M C O F E C H A Version 6.06P 29832

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QUALITY CONTROL AND DATING CHECK OF TREE-RING MEASUREMENTS

Title of run: VMC593\_ACSA\_Corr4-50 FINAL

File of DATED series: VMC593\_ACSA\_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 1907 to 2015 109 years

Continuous time span is 1907 to 2015 109 years

Portion with two or more series is 1912 to 2015 104 years

>> 311A 1994 absent in 1 of 34 series, but is not usually narrow: master index is .856

>> 308B 1963 absent in 1 of 32 series, but is not usually narrow: master index is .135

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

\*C\* Number of dated series 34 \*C\*

\*O\* Master series 1907 2015 109 yrs \*O\*

\*F\* Total rings in all series 2919 \*F\*

\*E\* Total dated rings checked 2914 \*E\*

\*C\* Series intercorrelation .551 \*C\*

\*H\* Average mean sensitivity .248 \*H\*

\*A\* Segments, possible problems 11 \*A\*

\*\*\* Mean length of series 85.9 \*\*\*

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

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

304B 1 absent rings: 1988

311A 1 absent rings: 1994

314A 1 absent rings: 1989

308B 3 absent rings: 1963 1964 1967

6 absent rings .206%

1950 .845 32 2000 -.267 34

1951 1.431 32 2001 -.368 34

1952 -.356 32 2002 1.086 34

1953 -.601 32 2003 -.146 34

1954 -.195 32 2004 .294 34

1955 .004 32 2005 .113 34

1956 -.949 32 2006 -2.190 34

1907 -.200 1 1957 -.662 32 2007 -1.651 34

1908 2.010 1 1958 -.406 32 2008 .574 34

1909 2.626 1 1959 -.584 32 2009 .626 34

1910 2.209 1 1960 -.608 32 2010 -2.090 34

1911 1.311 1 1961 .090 32 2011 .099 34

1912 -.397 3 1962 -.735 32 2012 .581 34

1913 .504 3 1963 .135 32 1<< 2013 .970 34

1914 .637 3 1964 -.971 32 1 2014 1.061 34

1915 .347 5 1965 -.862 32 2015 -1.518 34

1916 .880 6 1966 -1.225 32

1917 -.448 6 1967 -.581 32 1

1918 2.090 7 1968 -1.076 32

1919 -.932 7 1969 .658 34

1920 .336 9 1970 .438 34

1921 .089 10 1971 .095 34

1922 .544 11 1972 .573 34

1923 -.866 11 1973 .612 34

1924 .671 11 1974 .652 34

1925 -.414 13 1975 1.503 34

1926 -.744 15 1976 .371 34

1927 -1.370 15 1977 .605 34

1928 -2.574 16 1978 .404 34

1929 -.228 16 1979 -.537 34

1930 .462 18 1980 .355 34

1931 1.441 20 1981 -.320 34

1932 -.966 22 1982 -.074 34

1933 -.733 22 1983 -.876 34

1934 .108 25 1984 -.696 34

1935 .232 25 1985 -.349 34

1936 -1.394 25 1986 -3.507 34

1937 .473 27 1987 -1.406 34

1938 .510 27 1988 -.443 34 1

1939 .565 29 1989 -.438 34 1

1940 .550 29 1990 .622 34

1941 .986 29 1991 .768 34

1942 1.236 29 1992 .454 34

1943 .609 29 1993 .400 34

1944 -1.066 30 1994 .856 34 1<<

1945 -.921 31 1995 -1.104 34

1946 -.240 31 1996 -.401 34

1947 .941 31 1997 .088 34

1948 -1.332 31 1998 1.169 34

1949 .346 31 1999 1.774 34

PART 5: CORRELATION OF SERIES BY SEGMENTS: VMC593\_ACSA\_Corr4-50 14:10 Fri 02 Sep 2016 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 301A 1950 2015 .41 .52

2 301B 1934 2015 .34 .54 .55

3 302A 1926 2015 .39 .42 .63

4 302B 1930 2015 .45 .61 .58

5 304A 1944 2015 .44 .51 .72

6 304B 1931 2015 .40 .50 .60

7 305A 1932 2015 .24B .20B .22A

8 305B 1945 2015 .20A .31A .46

9 306A 1926 2015 .60 .51 .64

10 306B 1931 2015 .60 .69 .83

11 307A 1969 2015 .60

12 307B 1969 2015 .49

13 311A 1915 2015 .40 .60 .50 .62

14 311B 1925 2015 .54 .64 .69

15 313A 1912 2015 .55 .42 .50 .70

16 313B 1912 2015 .62 .39 .51 .66

17 314A 1922 2015 .69 .68 .59 .74

18 314B 1921 2015 .59 .59 .54 .66

19 1030A 1939 2015 .42 .54 .59

20 1030B 1930 2015 .33 .59 .72

21 1044A 1918 2015 .57 .36 .41 .23A

22 1044B 1916 2015 .53 .54 .48 .68

23 303A 1939 2015 .53 .64 .73

24 303B 1932 2015 .44 .56 .72

25 308B 1920 2015 .56 .51B .30B .46

26 309A 1934 2015 .53 .76 .77

27 309B 1937 2015 .11B .30A .42

28 310A 1915 2015 .46 .50 .53 .58

29 310B 1934 2015 .70 .44 .61

30 312A 1920 2015 .56 .56 .28B .37

31 312B 1925 2015 .64 .73 .76

32 1031A 1937 2015 .50 .37 .50

33 1031B 1907 2015 .59 .45 .59 .79

34 308A 1928 2015 .68 .54 .56

Av segment correlation .56 .47 .50 .60

PART 6: POTENTIAL PROBLEMS: VMC593\_ACSA\_Corr4-50 14:10 Fri 02 Sep 2016 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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301A 1950 to 2015 66 years Series 1

[B] Entire series, effect on correlation ( .426) is:

Lower 1968< -.056 1963< -.030 1999< -.023 1964> -.019 1969< -.016 1951< -.014 Higher 1986 .155 2000 .015

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

1967 1968 -4.1 SD

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

1968 -5.1 SD

301A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1950 328 218 210 223 168 165 178 116 109 144

1960 108 130 102 66 152 161 187 206 44 98

1970 181 240 256 329 338 417 340 374 347 291

1980 396 338 359 343 376 423 259 317 301 319

1990 346 309 311 285 336 295 340 301 334 225

2000 124 183 234 254 214 163 89 76 93 99

2010 72 150 247 253 237 130

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301B 1934 to 2015 82 years Series 2

[B] Entire series, effect on correlation ( .499) is:

Lower 1968< -.090 1952> -.020 1948> -.020 1941< -.016 2002< -.016 1983> -.008 Higher 1986 .116 2015 .012

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

1968 -5.7 SD

301B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1934 205 205 140 301 228 198

1940 191 138 199 139 124 149 170 227 202 220

1950 244 313 294 238 192 196 182 111 132 133

1960 194 171 187 190 181 181 170 219 98 193

1970 234 255 258 235 233 293 244 305 311 267

1980 335 239 282 289 254 276 144 238 221 218

1990 251 227 245 223 263 254 286 278 367 335

2000 281 256 221 181 241 265 208 223 319 258

2010 176 196 265 281 238 124

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302A 1926 to 2015 90 years Series 3

[B] Entire series, effect on correlation ( .515) is:

Lower 1947< -.020 1963< -.020 1936> -.019 1944> -.015 1995> -.014 1968> -.014 Higher 1986 .033 2010 .025

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

1948 -7.0 SD

302A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1926 52 56 37 179

1930 243 360 264 307 286 339 365 427 362 377

1940 366 357 396 347 351 376 354 285 164 268

1950 266 304 271 231 301 312 236 237 339 301

1960 223 266 203 117 170 106 93 92 199 175

1970 173 244 265 173 191 214 207 278 277 149

1980 225 219 228 135 124 160 80 146 159 217

1990 252 249 159 166 219 295 211 278 456 570

2000 297 289 519 403 349 470 254 278 425 219

2010 105 158 177 209 181 105

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302B 1930 to 2015 86 years Series 4

[B] Entire series, effect on correlation ( .557) is:

Lower 1968< -.055 1952> -.014 2010> -.011 1995> -.011 1973< -.008 1934< -.008 Higher 1986 .096 1999 .010

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

1968 -4.5 SD

302B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1930 251 287 178 177 154 188 165 280 350 341

1940 277 248 210 162 150 202 230 252 215 220

1950 311 410 314 204 261 277 185 178 279 263

1960 215 232 203 198 129 127 122 147 59 171

1970 140 113 133 115 182 196 160 139 146 101

1980 197 168 204 182 206 236 95 211 207 208

1990 259 267 174 201 238 214 128 155 211 313

2000 121 156 236 216 217 208 104 166 292 199

2010 101 109 113 217 193 105

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304A 1944 to 2015 72 years Series 5

[B] Entire series, effect on correlation ( .611) is:

Lower 1948> -.040 1953< -.024 1998< -.020 1968> -.019 1988< -.012 1957> -.010 Higher 2010 .060 1986 .058

304A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1944 258 290 249 441 416 371

1950 371 292 234 130 187 280 261 328 337 290

1960 212 215 214 224 206 198 215 232 234 239

1970 155 115 123 141 161 187 145 111 100 109

1980 122 138 151 100 114 105 49 95 91 123

1990 198 236 257 199 195 111 173 191 174 318

2000 223 250 293 262 219 270 210 225 336 272

2010 107 254 297 244 278 161

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304B 1931 to 2015 85 years Series 6

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

Lower 1988< -.137 1941< -.018 1975< -.015 1971< -.013 1974< -.010 1948> -.008 Higher 1986 .029 2010 .029

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

1987 1988 -5.7 SD

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

1988 -.443 34 1

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

1988 -6.1 SD

304B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1931 286 162 146 127 119 114 189 199 194

1940 218 171 197 200 191 205 223 356 289 311

1950 393 452 307 291 264 237 237 287 309 262

1960 261 237 188 258 214 213 191 208 186 249

1970 155 93 141 105 83 82 154 160 183 121

1980 112 113 97 79 90 96 47 146 0 73

1990 144 166 163 127 152 98 180 283 494 500

2000 301 296 362 280 298 283 166 138 161 164

2010 83 202 237 244 268 155

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305A 1932 to 2015 84 years Series 7

[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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1932 1981 8 -.01 -.02 .25 -.20 -.25 -.05 .11 .14 -.17 -.10 .24| .01 -.15 -.11 .12 -.21 -.05 .08 .37\* .09 .21

1950 1999 8 -.08 -.14 .25 -.14 -.13 .00 -.11 .19 -.15 .03 .20|-.04 .14 -.04 -.08 -.15 .10 -.03 .29\*-.01 .09

1966 2015 0 -.17 -.01 -.05 -.15 -.12 .00 -.18 .20 -.16 .15 .22\* - - - - - - - - - -

[B] Entire series, effect on correlation ( .265) is:

Lower 1986> -.035 1971< -.021 2008< -.018 1937< -.015 1966> -.013 1952> -.011 Higher 1948 .039 1964 .019

1932 to 1981 segment:

Lower 1971< -.029 1937< -.026 1966> -.026 1952> -.023 1968> -.020 1975< -.020 Higher 1948 .079 1964 .045

1950 to 1999 segment:

Lower 1986> -.072 1971< -.026 1966> -.022 1952> -.018 1975< -.018 1968> -.017 Higher 1964 .046 1956 .043

1966 to 2015 segment:

Lower 1986> -.046 1971< -.038 2008< -.031 1966> -.022 2004< -.018 1975< -.017 Higher 2006 .026 2002 .024

305A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1932 148 220 176 121 102 100 124 168

1940 190 188 181 192 152 137 179 152 121 132

1950 147 144 158 134 172 168 119 162 134 168

1960 140 170 156 159 111 131 163 146 151 144

1970 162 94 124 145 127 104 74 87 75 66

1980 122 148 144 136 79 101 110 78 102 66

1990 150 162 180 161 162 97 196 161 157 192

2000 131 124 191 85 36 52 38 5 13 70

2010 64 99 187 274 310 195

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305B 1945 to 2015 71 years Series 8

[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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1945 1994 0 -.10 -.03 .20 -.10 .04 .09 .06 .13 .05 .08 .20\*-.14 .01 .00 -.04 -.25 .05 .06 .07 -.07 -.19

1950 1999 0 -.16 .04 .23 -.11 .04 .10 .08 .16 .06 .03 .31\*-.10 -.02 -.08 -.07 -.17 .12 -.04 .04 -.06 -.17

[B] Entire series, effect on correlation ( .377) is:

Lower 1948> -.051 2006> -.030 1986> -.029 1989< -.018 1962> -.013 1983> -.012 Higher 2010 .077 2015 .029

1945 to 1994 segment:

Lower 1948> -.076 1986> -.026 1962> -.019 1983> -.017 1966> -.017 1965> -.015 Higher 1964 .057 1956 .027

1950 to 1999 segment:

Lower 1986> -.066 1962> -.023 1983> -.020 1966> -.020 1965> -.019 1989< -.017 Higher 1964 .039 1995 .031

305B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1945 209 221 244 261 251

1950 231 231 202 165 188 263 185 238 218 203

1960 211 240 258 231 120 220 231 177 139 147

1970 155 113 169 184 193 196 174 123 108 66

1980 89 137 163 164 101 117 93 69 53 16

1990 67 114 125 177 202 129 219 219 284 296

2000 249 183 287 266 319 310 309 312 425 409

2010 203 235 222 256 227 156

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306A 1926 to 2015 90 years Series 9

[B] Entire series, effect on correlation ( .632) is:

Lower 2015> -.021 1931< -.015 1936> -.015 1968> -.011 1958> -.010 1988> -.008 Higher 1948 .025 2006 .020

306A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1926 194 204 157 262

1930 289 215 169 142 216 204 201 267 273 246

1940 180 166 162 158 83 78 73 107 46 68

1950 62 58 42 51 37 43 38 35 93 57

1960 35 56 40 46 81 65 42 186 233 311

1970 272 339 316 345 276 300 249 283 299 240

1980 236 237 255 193 194 237 193 301 427 266

1990 293 363 311 341 349 252 210 227 233 348

2000 205 158 209 130 135 163 69 110 121 117

2010 73 119 125 139 129 96

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306B 1931 to 2015 85 years Series 10

[B] Entire series, effect on correlation ( .754) is:

Lower 1959< -.029 1931< -.017 1936> -.010 1964> -.010 1950< -.009 1967> -.008 Higher 1986 .046 2010 .029

306B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1931 109 86 77 137 169 134 157 182 190

1940 212 181 178 163 67 92 81 113 46 70

1950 58 70 43 54 63 68 51 52 83 33

1960 35 68 53 117 126 83 58 219 179 282

1970 301 271 236 257 206 322 181 239 201 171

1980 159 179 217 184 178 159 104 232 270 193

1990 199 260 251 266 330 212 224 300 308 360

2000 212 180 223 172 172 231 111 130 161 151

2010 58 152 216 170 149 84

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307A 1969 to 2015 47 years Series 11

[B] Entire series, effect on correlation ( .600) is:

Lower 1969< -.093 2010> -.035 1987< -.024 2009< -.013 1983> -.011 1995> -.010 Higher 1986 .096 2015 .050

307A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1969 99

1970 144 177 202 271 263 307 231 195 178 189

1980 231 160 153 186 193 151 86 71 277 242

1990 344 244 314 230 200 171 145 205 349 365

2000 256 203 225 210 290 205 115 77 272 198

2010 164 191 188 190 138 61

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307B 1969 to 2015 47 years Series 12

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

Lower 2003< -.052 1972< -.036 2010> -.024 1969< -.023 1995> -.019 1971> -.018 Higher 1986 .097 2015 .037

307B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1969 272

1970 301 436 279 261 274 397 274 262 238 245

1980 310 239 229 250 240 189 125 162 183 134

1990 257 266 353 376 391 296 225 227 251 250

2000 217 194 253 96 115 128 98 107 144 203

2010 137 199 225 173 140 60

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311A 1915 to 2015 101 years Series 13

[B] Entire series, effect on correlation ( .457) is:

Lower 1919> -.071 1994< -.035 1942< -.020 1984< -.019 1918< -.010 2006> -.010 Higher 2010 .030 1936 .013

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

1994 .856 34 1 >> WARNING: Ring is not usually narrow

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

1994 -4.6 SD

311A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1915 155 191 125 146 176

1920 200 193 171 137 159 140 137 179 179 238

1930 264 290 215 211 223 215 154 233 217 241

1940 249 268 183 214 116 137 202 225 163 193

1950 211 293 233 186 176 174 122 163 127 166

1960 140 157 133 122 77 79 85 102 87 118

1970 115 83 150 184 148 221 176 201 205 158

1980 201 178 168 143 38 109 69 114 72 120

1990 182 140 98 72 0 50 102 135 207 221

2000 103 107 145 102 85 84 92 73 135 151

2010 74 106 143 157 153 99

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311B 1925 to 2015 91 years Series 14

[B] Entire series, effect on correlation ( .649) is:

Lower 1953< -.022 1988< -.020 1968< -.016 1971< -.011 1948> -.009 1962> -.007 Higher 1986 .050 2006 .013

311B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1925 150 163 125 128 166

1930 196 221 185 184 225 245 192 228 224 293

1940 270 305 265 251 204 245 301 261 222 274

1950 289 300 217 151 182 215 205 229 176 147

1960 135 171 184 192 137 161 139 143 99 149

1970 154 122 185 242 173 267 202 257 185 184

1980 232 209 265 203 190 230 109 155 104 154

1990 245 215 171 178 293 124 186 222 248 278

2000 140 149 214 184 201 162 81 52 110 121

2010 81 126 150 148 182 97

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313A 1912 to 2015 104 years Series 15

[B] Entire series, effect on correlation ( .618) is:

Lower 1936> -.017 1917> -.016 1984< -.012 1968> -.011 1972< -.010 1932> -.009 Higher 2010 .034 2006 .021

313A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1912 10 18 24 32 40 54 110 52

1920 70 37 74 40 66 46 35 47 32 88

1930 119 219 193 248 306 282 300 330 289 300

1940 265 295 273 271 234 205 221 254 225 246

1950 230 295 222 207 206 225 196 269 263 286

1960 229 272 261 349 227 233 192 181 217 228

1970 178 142 122 115 125 166 146 194 179 158

1980 179 171 155 124 78 81 65 90 88 88

1990 112 101 91 83 86 61 70 74 85 111

2000 87 113 116 98 95 125 61 90 152 125

2010 37 139 144 154 147 59

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313B 1912 to 2015 104 years Series 16

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

Lower 1948> -.027 1958< -.019 2004< -.013 1968> -.013 1936> -.011 1917> -.010 Higher 1919 .042 2010 .030

313B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1912 9 17 27 33 40 47 109 36

1920 94 62 97 66 91 61 53 56 41 88

1930 132 220 155 185 207 290 269 270 234 366

1940 353 320 333 330 306 289 280 348 342 383

1950 402 401 229 235 226 225 190 262 155 166

1960 187 238 243 269 170 219 218 240 246 194

1970 149 121 118 175 214 265 190 167 157 124

1980 128 86 98 108 89 111 77 85 99 96

1990 136 127 156 137 137 93 111 120 110 165

2000 122 134 143 101 87 109 86 103 123 148

2010 85 136 190 232 211 130

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314A 1922 to 2015 94 years Series 17

[B] Entire series, effect on correlation ( .634) is:

Lower 1989< -.083 1986> -.016 1926> -.016 1954< -.010 2005< -.009 1936> -.008 Higher 2010 .035 1948 .018

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

1989 -.438 34 1

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

1989 -6.4 SD

314A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 133 102 149 132 202 118 68 108

1930 129 236 150 209 254 296 258 262 259 295

1940 307 308 308 284 224 237 262 294 201 285

1950 247 258 185 179 150 177 166 154 140 166

1960 151 160 131 213 156 142 136 115 112 118

1970 135 144 155 164 195 218 182 161 179 144

1980 126 121 118 122 113 88 58 46 53 0

1990 37 76 79 93 104 67 77 90 160 163

2000 87 88 110 82 94 51 27 45 80 114

2010 42 86 114 126 105 80

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314B 1921 to 2015 95 years Series 18

[B] Entire series, effect on correlation ( .627) is:

Lower 2015> -.021 1964> -.017 1954< -.016 1980< -.011 1971< -.009 1960< -.009 Higher 1986 .030 2010 .020

314B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1921 145 128 116 158 119 135 102 83 139

1930 179 337 235 295 296 270 206 306 304 319

1940 322 310 355 340 269 259 302 305 187 314

1950 271 319 259 254 200 278 225 261 232 222

1960 173 191 200 283 278 209 242 282 254 294

1970 204 167 222 216 201 245 177 176 168 159

1980 137 150 143 125 118 117 83 94 153 115

1990 133 188 152 128 164 103 104 109 172 176

2000 119 117 115 68 70 54 28 50 57 61

2010 12 38 85 107 109 72

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1030A 1939 to 2015 77 years Series 19

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

Lower 1939< -.090 1994< -.017 1998< -.014 1948> -.013 1956> -.012 1975< -.010 Higher 1986 .055 2010 .032

1030A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1939 52

1940 126 130 172 199 141 156 164 203 176 216

1950 214 234 150 183 167 174 195 141 160 183

1960 228 167 135 217 147 148 113 150 173 248

1970 151 163 243 245 224 160 151 154 126 76

1980 122 103 127 122 89 81 40 125 131 209

1990 195 228 188 193 105 29 183 210 144 221

2000 193 233 241 248 246 235 129 53 125 158

2010 61 93 173 207 232 129

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1030B 1930 to 2015 86 years Series 20

[B] Entire series, effect on correlation ( .586) is:

Lower 1948> -.044 1940< -.029 1962> -.012 2006> -.011 1945> -.011 1978< -.009 Higher 2010 .057 1986 .042

1030B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1930 117 133 106 133 138 139 125 149 177 153

1940 135 176 208 188 189 227 188 246 246 252

1950 224 259 204 221 158 163 159 142 167 184

1960 177 200 240 308 217 218 158 126 168 182

1970 151 240 190 140 220 229 191 187 120 131

1980 157 109 148 129 109 134 53 103 137 154

1990 250 253 323 268 248 153 160 205 231 283

2000 172 193 239 206 269 276 225 288 339 358

2010 95 313 307 279 246 158

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1044A 1918 to 2015 98 years Series 21

[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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1966 2015 0 -.13 -.09 .01 .08 .07 -.16 -.21 .12 -.05 -.10 .23\* - - - - - - - - - -

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

Lower 2013< -.049 2006> -.030 2010> -.026 1964> -.021 1928> -.019 1926< -.015 Higher 1919 .076 1936 .016

1966 to 2015 segment:

Lower 2013< -.099 2006> -.050 2010> -.035 1973< -.028 1975< -.021 2012< -.014 Higher 1986 .074 2002 .027

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

2013 -4.8 SD

1044A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1918 235 162

1920 193 193 198 157 238 182 100 139 165 263

1930 255 231 141 93 125 162 86 124 112 86

1940 68 64 62 51 34 19 18 33 26 33

1950 64 82 80 74 69 71 42 37 28 14

1960 15 38 43 76 148 97 63 177 145 218

1970 128 154 160 70 75 60 105 114 93 86

1980 102 65 51 62 61 58 43 53 177 207

1990 332 343 314 330 401 311 357 366 418 429

2000 338 309 378 278 311 288 300 260 256 282

2010 244 218 159 86 89 89

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1044B 1916 to 2015 100 years Series 22

[B] Entire series, effect on correlation ( .603) is:

Lower 1964> -.013 1957< -.012 1928> -.012 1926> -.011 1927> -.009 1956> -.008 Higher 2010 .025 2015 .021

1044B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1916 162 146 229 163

1920 149 153 131 132 222 225 239 209 169 195

1930 171 146 103 75 82 72 35 93 109 81

1940 89 91 85 85 43 41 57 94 45 46

1950 69 89 76 70 79 71 72 39 43 44

1960 59 60 41 55 90 69 65 88 103 162

1970 146 151 214 190 220 238 159 105 118 103

1980 97 58 68 92 107 93 62 62 200 227

1990 183 283 239 210 280 185 317 353 339 344

2000 318 306 384 272 256 214 208 228 312 300

2010 201 265 284 306 273 157

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303A 1939 to 2015 77 years Series 23

[B] Entire series, effect on correlation ( .578) is:

Lower 1939< -.045 1948> -.027 1988< -.020 1956> -.018 1944> -.015 1963< -.013 Higher 1986 .112 2015 .032

303A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1939 198

1940 250 267 282 274 244 207 208 216 203 205

1950 205 211 124 150 150 146 167 118 106 119

1960 161 152 98 65 67 70 63 83 66 101

1970 149 152 203 171 141 144 133 152 131 136

1980 160 116 142 96 131 149 73 101 85 159

1990 184 199 208 180 217 191 180 199 255 225

2000 220 170 304 262 252 171 142 118 180 199

2010 133 165 174 162 158 84

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303B 1932 to 2015 84 years Series 24

[B] Entire series, effect on correlation ( .630) is:

Lower 1995> -.024 1948> -.022 1983< -.020 1938< -.020 1959< -.012 1944> -.011 Higher 1986 .067 2010 .051

303B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1932 126 135 176 187 178 176 142 177

1940 182 250 299 255 216 204 183 222 194 217

1950 193 233 154 176 160 101 102 80 111 60

1960 152 126 102 118 93 89 90 118 155 189

1970 241 219 226 201 201 213 185 178 156 144

1980 169 118 189 102 167 178 98 121 171 232

1990 222 217 245 203 248 243 213 173 226 204

2000 171 166 203 183 207 163 130 115 161 197

2010 88 144 150 178 169 90

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

308B 1920 to 2015 96 years Series 25

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

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

1925 1974 4 -.14 .01 .13 .01 -.17 -.25 .47 -.04 -.03 -.20 .51| .06 -.13 -.27 .53\*-.09 .02 -.11 .27 -.05 -.04

1950 1999 1 -.17 -.16 .20 -.05 -.10 -.37 .04 -.19 -.14 .06 .30| .30\*-.03 .23 .30 .11 .08 -.02 .03 .06 .08

[B] Entire series, effect on correlation ( .488) is:

Lower 2010> -.057 1986> -.022 1995> -.014 1930< -.012 1933> -.011 1989> -.010 Higher 2006 .043 2015 .042

1925 to 1974 segment:

Lower 1930< -.029 1933> -.024 1929< -.023 1963< -.022 1947< -.018 1971> -.016 Higher 1948 .072 1932 .050

1950 to 1999 segment:

Lower 1963< -.029 1995> -.028 1989> -.026 1971> -.018 1957> -.015 1972< -.014 Higher 1952 .042 1999 .033

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

1932 1933 4.3 SD

[D] 3 Absent rings: Year Master N series Absent

1963 .135 32 1 >> WARNING: Ring is not usually narrow

1964 -.971 32 1

1967 -.581 32 1

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

1932 -4.5 SD

308B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1920 63 70 103 84 90 84 64 62 54 47

1930 39 82 27 154 128 192 144 182 217 269

1940 239 374 413 451 307 289 289 246 156 189

1950 292 244 152 150 159 117 99 137 98 68

1960 39 21 24 0 0 19 14 0 7 33

1970 57 100 65 41 50 50 58 64 58 45

1980 45 47 42 41 56 41 31 47 170 387

1990 356 462 322 389 326 335 310 265 292 356

2000 224 154 232 224 223 224 128 183 276 294

2010 327 303 331 292 289 169

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309A 1934 to 2015 82 years Series 26

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

Lower 1948> -.028 2010> -.012 1935< -.010 1943< -.010 2000> -.009 1950< -.009 Higher 1986 .082 2006 .016

309A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1934 230 180 162 201 244 216

1940 221 297 324 225 209 188 288 315 282 393

1950 280 299 252 214 271 322 237 279 239 216

1960 202 242 172 272 209 148 156 189 145 244

1970 246 208 261 308 341 334 277 266 361 284

1980 258 279 248 238 267 215 118 178 257 215

1990 266 239 214 285 292 184 166 187 218 226

2000 218 229 266 229 238 195 137 126 199 211

2010 163 239 245 235 227 145

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

309B 1937 to 2015 79 years Series 27

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

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

1937 1986 3 .17 .20 -.10 -.08 .01 -.03 -.05 -.11 .15 .18 .11| .16 -.01 .21\*-.03 -.26 -.14 .17 -.04 -.13 .03

1950 1999 0 .03 -.02 -.08 -.07 .24 -.10 -.04 .08 .15 -.26 .30\* .28 .08 .16 .23 -.06 -.06 -.10 -.13 -.06 .10

[B] Entire series, effect on correlation ( .232) is:

Lower 1937< -.080 1948> -.030 1944> -.027 1968> -.019 2002< -.012 1955< -.010 Higher 2015 .043 1969 .016

1937 to 1986 segment:

Lower 1937< -.108 1948> -.045 1944> -.040 1968> -.028 1952> -.011 1955< -.011 Higher 1969 .032 1986 .024

1950 to 1999 segment:

Lower 1968> -.046 1955< -.028 1987> -.025 1985< -.023 1992< -.017 1952> -.016 Higher 1969 .030 1956 .022

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

1987 +3.2 SD

309B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1937 340 348 384

1940 358 362 354 323 388 235 325 428 411 465

1950 394 313 286 273 225 136 127 210 178 216

1960 203 285 210 264 264 271 227 272 440 628

1970 376 382 387 387 350 360 330 412 495 335

1980 436 413 276 174 250 165 163 392 307 238

1990 195 177 130 206 263 181 189 216 207 207

2000 133 94 120 125 319 393 244 174 249 246

2010 216 339 314 385 414 218

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310A 1915 to 2015 101 years Series 28

[B] Entire series, effect on correlation ( .515) is:

Lower 1919> -.041 1995> -.025 1948> -.025 1950< -.019 2012< -.014 1996< -.013 Higher 1986 .086 2006 .019

310A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1915 49 108 90 137 118

1920 124 130 131 126 124 107 109 73 48 159

1930 273 438 335 288 278 364 278 461 387 355

1940 319 407 600 410 276 264 291 336 332 323

1950 218 204 160 144 196 183 176 158 169 199

1960 226 244 183 173 117 159 136 142 120 132

1970 142 125 119 137 147 177 206 246 223 205

1980 178 181 190 152 212 225 149 179 242 219

1990 232 221 215 220 222 308 198 274 365 427

2000 322 302 259 196 249 177 108 107 167 138

2010 111 137 89 96 160 93

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310B 1934 to 2015 82 years Series 29

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

Lower 1991< -.022 1990< -.018 1999< -.014 1934< -.010 1984> -.009 1988< -.009 Higher 2006 .029 1948 .023

310B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1934 263 317 259 447 431 516

1940 452 486 523 388 292 234 268 294 151 255

1950 270 296 221 151 185 172 160 189 168 196

1960 186 182 116 174 100 119 78 112 95 120

1970 192 165 147 202 223 270 227 231 191 199

1980 217 175 173 120 200 242 132 96 89 161

1990 114 92 116 133 151 121 132 150 176 136

2000 114 113 168 145 136 114 78 118 157 176

2010 109 170 152 144 163 117

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312A 1920 to 2015 96 years Series 30

[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 -9 -.05 .34\*-.04 -.29 -.04 -.15 -.16 .13 -.07 -.10 .28| .04 -.01 .09 .27 .22 .08 -.14 -.08 -.11 -.09

[B] Entire series, effect on correlation ( .440) is:

Lower 1982< -.058 1986> -.042 1933< -.013 1963< -.011 2012< -.009 1953> -.008 Higher 1948 .022 2010 .017

1950 to 1999 segment:

Lower 1986> -.088 1982< -.087 1963< -.020 1953> -.016 1952> -.013 1987> -.010 Higher 1995 .087 1951 .020

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

1982 -4.7 SD

312A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1920 143 151 158 129 220 205 215 178 159 220

1930 214 220 185 139 218 223 179 267 261 228

1940 221 251 238 218 149 202 185 193 134 196

1950 249 276 232 276 239 221 189 131 146 178

1960 132 157 124 90 144 129 153 140 203 391

1970 407 408 350 349 297 367 237 268 327 262

1980 262 230 117 169 266 286 262 340 311 222

1990 317 260 259 291 289 145 256 214 225 263

2000 153 160 257 225 235 250 191 217 202 199

2010 134 141 123 188 167 121

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312B 1925 to 2015 91 years Series 31

[B] Entire series, effect on correlation ( .729) is:

Lower 1967< -.025 1932> -.024 1944> -.014 1926> -.013 1963< -.009 1991< -.007 Higher 1986 .041 2010 .019

312B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1925 224 257 231 198 259

1930 251 287 277 226 252 242 177 245 258 316

1940 273 316 283 247 224 177 184 184 108 155

1950 224 235 166 153 152 124 109 106 114 104

1960 97 113 102 81 68 74 100 50 102 187

1970 160 211 234 234 215 347 225 277 281 189

1980 178 164 165 158 170 178 98 124 128 117

1990 123 118 156 140 162 91 172 184 248 255

2000 137 153 196 175 200 204 147 155 171 150

2010 102 116 117 147 133 96

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1031A 1937 to 2015 79 years Series 32

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

Lower 1994< -.066 1949< -.024 1945> -.022 1977< -.018 2000> -.014 1998< -.010 Higher 1948 .045 1986 .041

1031A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1937 165 160 171

1940 205 159 127 110 101 164 122 167 77 55

1950 107 83 52 73 102 76 60 47 80 53

1960 80 91 89 131 105 112 100 83 214 550

1970 483 545 419 371 358 340 187 155 228 279

1980 389 309 344 275 313 330 204 297 354 284

1990 263 433 309 346 132 101 79 95 112 138

2000 180 211 270 219 239 157 65 70 246 151

2010 88 121 132 176 264 143

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1031B 1907 to 2015 109 years Series 33

[\*] Early part of series cannot be checked from 1907 to 1911 -- not matched by another series

[B] Entire series, effect on correlation ( .685) is:

Lower 1949< -.023 1936> -.012 1945> -.012 1968> -.009 1944> -.009 1959< -.008 Higher 1919 .034 2010 .028

1031B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1907 84 107 115

1910 102 82 62 61 55 55 44 25 58 9

1920 19 22 68 43 55 31 17 21 17 181

1930 216 152 21 24 112 114 118 137 135 154

1940 166 177 208 160 127 155 105 129 84 54

1950 64 68 48 71 92 62 64 42 72 33

1960 82 86 79 93 94 77 58 48 204 469

1970 423 489 475 529 438 496 300 345 322 215

1980 216 168 203 128 137 156 85 104 167 131

1990 159 128 84 82 69 49 50 58 210 232

2000 143 161 167 162 232 213 101 121 260 335

2010 142 215 235 192 193 115

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308A 1928 to 2015 88 years Series 34

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

Lower 2010> -.095 1929< -.015 1995> -.014 1970> -.010 1989> -.007 2012< -.006 Higher 1986 .035 2006 .028

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

2010 +3.3 SD

308A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1928 36 37

1930 113 187 123 158 155 191 147 286 266 259

1940 240 283 286 254 147 168 196 218 126 201

1950 187 171 147 168 227 129 29 24 37 13

1960 13 7 6 15 10 23 28 29 20 87

1970 196 178 141 78 51 101 67 43 52 36

1980 46 49 37 74 85 183 49 41 126 294

1990 389 466 311 372 424 363 247 266 267 323

2000 224 206 258 199 173 167 96 113 210 192

2010 256 217 176 229 230 146

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PART 7: DESCRIPTIVE STATISTICS: VMC593\_ACSA\_Corr4-50 14:10 Fri 02 Sep 2016 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 301A 1950 2015 66 2 0 .426 2.33 4.23 1.008 .829 .242 2.47 .383 -.019 1

2 301B 1934 2015 82 3 0 .499 2.25 3.67 .566 .557 .191 2.48 .337 -.077 1

3 302A 1926 2015 90 3 0 .515 2.50 5.70 1.055 .689 .260 2.38 .326 .056 1

4 302B 1930 2015 86 3 0 .557 1.99 4.10 .652 .514 .261 2.47 .392 -.088 2

5 304A 1944 2015 72 3 0 .611 2.13 4.41 .824 .730 .225 2.52 .421 -.037 2

6 304B 1931 2015 85 3 0 .442 2.02 5.00 .949 .773 .272 2.47 .337 -.062 1

7 305A 1932 2015 84 3 3 .265 1.36 3.10 .507 .681 .276 2.46 .478 -.051 1

8 305B 1945 2015 71 3 2 .377 1.97 4.25 .777 .786 .230 2.53 .459 -.020 1

9 306A 1926 2015 90 3 0 .632 1.81 4.27 .989 .855 .249 2.65 .419 -.065 1

10 306B 1931 2015 85 3 0 .754 1.62 3.60 .800 .759 .285 2.56 .525 -.059 1

11 307A 1969 2015 47 1 0 .600 2.03 3.65 .714 .477 .279 2.74 .667 .254 3

12 307B 1969 2015 47 1 0 .489 2.27 4.36 .840 .696 .227 2.71 .504 .019 1

13 311A 1915 2015 101 4 0 .457 1.54 2.93 .570 .705 .284 2.65 .441 -.038 1

14 311B 1925 2015 91 3 0 .649 1.90 3.05 .568 .581 .233 2.60 .569 .039 1

15 313A 1912 2015 104 4 0 .618 1.54 3.49 .865 .903 .239 2.70 .402 .003 2

16 313B 1912 2015 104 4 0 .631 1.68 4.02 .933 .891 .231 2.84 .450 -.066 3

17 314A 1922 2015 94 4 0 .634 1.50 3.08 .738 .867 .262 2.67 .403 -.014 1

18 314B 1921 2015 95 4 0 .627 1.84 3.55 .854 .853 .222 2.49 .367 -.034 1

19 1030A 1939 2015 77 3 0 .469 1.63 2.48 .538 .520 .295 2.50 .490 -.025 1

20 1030B 1930 2015 86 3 0 .586 1.94 3.58 .621 .572 .216 2.49 .379 -.085 1

21 1044A 1918 2015 98 4 1 .415 1.53 4.28 1.098 .913 .261 2.60 .428 -.050 1

22 1044B 1916 2015 100 4 0 .603 1.53 3.84 .907 .882 .227 2.56 .481 .004 1

23 303A 1939 2015 77 3 0 .578 1.64 3.04 .566 .780 .188 2.57 .430 -.027 1

24 303B 1932 2015 84 3 0 .630 1.71 2.99 .491 .667 .205 2.53 .457 -.088 1

25 308B 1920 2015 96 4 2 .488 1.62 4.62 1.231 .894 .347 2.67 .469 -.025 1

26 309A 1934 2015 82 3 0 .690 2.35 3.93 .543 .525 .189 2.52 .375 .094 1

27 309B 1937 2015 79 3 2 .232 2.88 6.28 1.038 .668 .226 2.75 .499 -.024 2

28 310A 1915 2015 101 4 0 .515 2.09 6.00 .994 .810 .206 2.66 .396 .000 1

29 310B 1934 2015 82 3 0 .636 1.95 5.23 1.001 .860 .225 2.46 .449 -.016 1

30 312A 1920 2015 96 4 1 .440 2.18 4.08 .686 .678 .202 2.48 .422 -.016 1

31 312B 1925 2015 91 3 0 .729 1.78 3.47 .648 .779 .188 2.66 .548 -.069 1

32 1031A 1937 2015 79 3 0 .489 1.93 5.50 1.208 .793 .302 2.74 .569 .081 1

33 1031B 1907 2015 109 4 0 .685 1.41 5.29 1.138 .854 .329 2.64 .439 -.045 1

34 308A 1928 2015 88 3 0 .629 1.58 4.66 1.072 .848 .341 2.69 .486 .034 1

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Total or mean: 2919 108 11 .551 1.86 6.28 .830 .751 .248 2.84 .443 -.020

- = [ COFECHA VMC59COF ] = -