

NEWS PRESENCE OF ASTEROID NAMES RELATES TO ANGLES TO SUN

-- COLLECTION STARTED ON FEB 15, 2022-- EVALUATED DAILY UNTIL CIRCA FEB 15, 2027 -- HERE ARE DAILY AGGREGATE RESULTS

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In[1]:= (*Today's Date and Time of Collection & Reporting UTC*)
Style[DateString[TimeZoneConvert[DateObject[Date[]], "UTC"]], "Subtitle"]

Out[1]= Mon 12 Dec 2022 07:39:39

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(*use your own directory here*)

In[3]:= sundata = Import["MinorPlanetSunData.csv"][[All ;; -2]];

In[4]:= sundata[[1]]

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 8420 Angroyna (1996 WQ) , 22442 Blaha (1996 TM9) , 26757 Bastei (2001 KU17) ,
 928 Hildrun (1920 GP) , 20323 Tomlindstrom (1998 HC21) , 3996 Fugaku (1988 XG1) ,
 7015 Schopenhauer (1990 QC8) , 6332 Vorarlberg (1992 FP3) , 777 Gutemberga (1914 TZ) ,
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 9661 Hohmann (1996 FU13) , 8906 Yano (1995 WF2) , 5239 Reiki (1990 VC4) ,
 786 Bredichina (1914 UO) , 6128 Lasorda (1989 LA) , 22581 Rosahemphill (1998 HH77) ,
 3523 Arina (1975 TV2) , 11147 Delmas (1997 XT5) , 17720 Manuboccuni (1997 XH10) ,
 17097 Ronneuman (1999 JX31) , 1841 Masaryk (1971 UO1) , 11322 Aquamarine (1995 QT) ,
 1244 Deira (1932 KE) , 22998 Waltmyer (1999 VY70) , 8443 Svecica (4343 T-3) ,
 10965 van Leverink (3297 T-1) , 1269 Rollandia (1930 SH) , 3765 Texereau (1982 SU1) , }

- 721 Tabora (1911 MZ) , 8296 Miyama (1993 AD) , 7506 Lub (4837 P-L) ,
9657 Ucka (1996 DG2) , 2307 Garuda (1957 HJ) , 24778 Nemsu (1993 KW1) ,
3047 Goethe (6091 P-L) , 9154 Kol'tsovo (1982 SP6) , 2890 Vilyujsk (1978 SY7) ,
897 Lysistrata (1918 DZ) , 20964 Mons Naklethi (1977 UA) , 1859 Kovalevskaya (1972 RS2) ,
3803 Tuchkova (1981 TP1) , 19517 Robertocarlos (1998 SK164) , 3654 AAS (1949 QH1) ,
5837 Hedin (2548 P-L) , 29 Amphitrite , 8966 Hortulana (3287 T-1) ,
7665 Putignano (1994 TK3) , 1592 Mathieu (1951 LA) , 1550 Tito (1937 WD) ,
368 Haidea (1893 AB) , 24028 Veronicaduys (1999 RP182) , 13234 Natashaowen (1998 FC74) ,
2225 Serkowski (6546 P-L) , 2866 Hardy (1961 TA) , 994 Otthild (1923 NL) ,
26821 Baehr (1988 FM1) , 1263 Varsavia (1933 FF) , 8001 Ramsden (1986 TR3) ,
5544 Kazakov (1978 TH6) , 1233 Kobresia (1931 TG2) , 1299 Mertona (1934 BA) ,
16085 Laffan (1999 TM27) , 5196 Bustelli (3102 T-2) , 7565 Zipfel (1988 RD11) ,
2882 Tedesco (1981 OG) , 1669 Dagmar (1934 RS) , 1409 Isko (1937 AK) ,
2230 Yunnan (1978 UT1) , 1354 Botha (1935 GK) , 11006 Gilson (1980 TZ3) ,
8117 Yuanlongping (1996 SD1) , 5366 Rhianjones (1981 EY30) , 544 Jetta (1904 OU) ,
20840 Borishanin (2000 UF58) , 1538 Detre (1940 RF) , 11129 Hayachine (1996 VS5) ,
3342 Fivesparks (1982 BD3) , 21432 Polingloh (1998 FJ115) , 706 Hirundo (1910 KX) ,
16908 Groeselenberg (1998 DD33) , 7788 Tsukuba (1994 XS) , 4488 Tokitada (1987 UK) ,
11444 Peshekhonov (1978 QA2) , 20309 Batalden (1998 FD110) , 19420 Vivekbuch (1998 FB54) ,
6218 Mizushima (1977 EG7) , 9255 Inoutadataka (3174 T-1) , 4544 Xanthus (1989 FB) ,
6966 Vietoris (1991 RD5) , 8574 Makotoirie (1996 VC2) , 18376 Quirk (1991 SQ) ,
8347 Lallaward (1987 HK) , 5568 Mufson (1953 TS2) , 15128 Patrickjones (2000 EG46) ,
18818 Yasuhiko (1999 MB2) , 8387 Fujimori (1993 DO) , 12191 Vorontsova (1978 TT8) ,
402920 Tsawout (2007 TH142) , 204 Kallisto , 20837 Ramanlal (2000 UX52) ,
5757 Ticha (1967 JN) , 5824 Inagaki (1989 YM) , 11945 Amsterdam (1993 PC5) ,

- 9022 Drake (1988 PC1) , 643 Scheherezade (1907 ZZ) , 9822 Hajdukova (4114 T-1) ,
2654 Ristenpart (1968 OG) , 3557 Sokolsky (1977 QE1) , 10638 McGlothlin (1998 SV54) ,
5861 Glynjones (1982 RW) , 10927 Vaucluse (1998 BB42) , 23730 Suncar (1998 HX89) ,
17076 Betti (1999 HO) , 9813 Rozgaj (1998 TP5) , 775 Lumiere (1914 TX) ,
5432 Imakiire (1988 VN) , 12722 Petrarca (1991 PT1) , 2170 Byelorussia (1971 SZ) ,
306367 Nut (5025 P-L) , 6865 Dunkerley (1991 TE2) , 2347 Vinata (1936 TK) ,
7599 Munari (1994 PB) , 11790 Goode (1978 RU) , 7011 Worley (1987 SK1) ,
2854 Rawson (1964 JE) , 6800 Saragamine (1994 UC) , 6761 Haroldconnolly (1981 EV19) ,
4020 Dominique (1981 ET38) , 1848 Delvaux (1933 QD) , 18679 Heatherenae (1998 FW102) ,
4014 Heizman (1979 SG10) , 31823 Viete (1999 TN3) , 3192 A'Hearn (1982 BY1) ,
20272 Duyha (1998 FH33) , 5981 Kresilas (2140 P-L) , 22562 Wage (1998 HC19) ,
2891 McGetchin (1980 MD) , 689 Zita (1909 HJ) , 21571 Naegeli (1998 RD51) ,
5852 Nanette (1991 HO) , 5095 Escalante (1983 NL) , 16251 Barbifrank (2000 HX48) ,
20480 Antonschraut (1999 NT31) , 18117 Jonhodge (2000 NY23) ,
88611 Teharonhiawako (2001 QT297) , 11241 Eckhout (6792 P-L) ,
6995 Minoyama (1996 BZ1) , 4252 Godwin (1985 RG4) , 569 Misa (1905 QT) ,
16203 Jessicastahl (2000 CH32) , 6603 Marycragg (1990 KG) , 6474 Choate (1987 SG1) ,
17220 Johnpenna (2000 CX26) , 5243 Clasien (1246 T-2) , 17173 Evgenyamosov (1999 RN10) ,
16672 Bedini (1994 BA1) , 3080 Moisseiev (1935 TE) , 13176 Kobedaitenken (1996 HE1) ,
19475 Mispagel (1998 HA91) , 3584 Aisha (1981 TW) , 7704 Dellen (1992 EB7) ,
3036 Krat (1937 TO) , 3262 Miune (1983 WB) , 17892 Morecambewise (1999 EO5) ,
17486 Hodler (1991 RB41) , 7551 Edstolper (1981 EF26) , 4049 Noragal' (1973 QD2) ,
18268 Dardanos (2140 T-3) , 7279 Hagfors (1985 VD1) , 2479 Sodankyla (1942 CB) ,
12013 Sibatahosimi (1996 VU8) , 13062 Podarkes (1991 HN) , 6744 Komoda (1994 JL) ,
5654 Terni (1993 KG) , 3538 Nelsonia (6548 P-L) , 2005 Hencke (1973 RA) ,

- 632 Pyrrha (1907 YX) , 21369 Gertfinger (1997 NO4) , 8538 Gammelmaja (1993 FR26) ,
21454 Chernobyl (1998 HE40) , 3953 Perth (1986 VB6) , 7512 Monicalazzarin (1983 CA1) ,
2138 Swissair (1968 HB) , 2869 Nepryadva (1980 RM2) , 2907 Nekrasov (1975 TT2) ,
9426 Aliante (1996 CO7) , 3716 Petzval (1980 TG) , 12368 Mutsaers (1994 CM11) ,
6979 Shigefumi (1993 RH) , 31238 Kromeriz (1998 DT1) , 5840 Raybrown (1978 ON) ,
21647 Carlturner (1999 NE54) , 1929 Kollaa (1939 BS) , 6102 Visby (1993 FQ25) ,
725 Amanda (1911 ND) , 4159 Freeman (1989 GK) , 4797 Ako (1989 SJ) ,
1192 Prisma (1931 FE) , 15382 Vian (1997 SN) , 13982 Thunberg (1992 RB3) ,
37786 Tokikonaruko (1997 SS17) , 5354 Hisayo (1990 BJ2) , 16199 Rozenblyum (2000 BX26) ,
18935 Alfandmedina (2000 QE37) , 12750 Berthollet (1993 DJ1) , 10740 Fallersleben (1988 RX2) ,
1528 Conrada (1940 CA) , 8150 Kaluga (1985 QL4) , 6323 Karoji (1991 CY1) ,
13853 Jenniferfritz (1999 XR96) , 5936 Khadzhinov (1979 FQ2) , 57 Mnemosyne ,
27719 Fast (1989 SR3) , 712 Boliviana (1911 LO) , 10119 Remarque (1992 YC1) ,
6708 Bobbievaile (1989 AA5) , 46392 Bertola (2002 AO6) , 4547 Massachusetts (1990 KP) ,
5650 Mochihito-o (1990 XK) , 3786 Yamada (1988 AE) , 22862 Janinedavis (1999 RG152) ,
11506 Toulouse-Lautrec (1990 ES1) , 1361 Leuschneria (1935 QA) ,
11311 Peleus (1993 XN2) , 4606 Saheki (1987 UM1) , 1566 Icarus (1949 MA) ,
15846 Billfyfe (1995 UK28) , 11852 Shoumen (1988 RD) , 20474 Reasoner (1999 NV9) ,
49501 Basso (1999 CN10) , 13638 Fiorenza (1996 CJ7) , 4242 Brecher (1981 FQ) ,
14129 Dibucci (1998 QO95) , 9033 Kawane (1990 AD) , 9447 Julesbordet (1997 JJ18) ,
4917 Yurilvovia (1973 SC6) , 10601 Hiwatashi (1996 UC) , 6557 Yokonomura (1990 VR3) ,
7626 Iafe (1976 QL2) , 15077 Edyalge (1999 CA) , 5040 Rabinowitz (1972 RF) ,
2569 Madeline (1980 MA) , 5456 Merman (1979 HH3) , 24999 Hieronymus (1998 OY4) ,
9238 Yavapai (1997 HO2) , 11593 Uchikawa (1995 HK) , 7717 Tabeissi (1997 AL5) ,
7054 Brehm (1989 GL8) , 19593 Justinkoh (1999 NZ29) , 1868 Thersites (2008 P-L) ,

- 753 Tiflis (1913 RM) , 11348 Allegra (1997 BG9) , 9689 Freudenthal (4831 P-L) ,
- 3238 Timresovia (1975 VB9) , 7291 Hyakutake (1991 XC1) , 18702 Sadowski (1998 HG68) ,
- 522 Helga (1904 NC) , 8236 Gainsborough (4040 P-L) , 7766 Jododaira (1991 BH2) ,
- 2510 Shandong (1979 TH) , 10720 Danzl (1986 GY) , 5865 Qualytemocrina (1984 QQ) ,
- 10167 Yoshiwatiso (1995 BQ15) , 7461 Kachmokiam (1984 TD) , 5683 Bifukumonin (1990 UD) ,
- 13009 Voloshchuk (1985 PB2) , 579 Sidonia (1905 SD) , 896 Sphinx (1918 DV) ,
- 1732 Heike (1943 EY) , 794 Irenaea (1914 VB) , 20834 Allihewlett (2000 UM48) ,
- 23011 Petach (1999 VG163) , 5875 Kuga (1989 XO) , 561 Ingwelde (1905 QG) ,
- 1757 Porvoo (1939 FC) , 21363 Jotwani (1997 HX11) , 6051 Anaximenes (1992 BX1) ,
- 2180 Marjaleena (1940 RJ) , 3052 Herzen (1976 YJ3) , 7203 Sigeki (1995 DG2) ,
- 3087 Beatrice Tinsley (1981 QJ1) , 3337 Milos (1971 UG1) , 5871 Bobbell (1989 CE2) ,
- 7623 Stamitz (9508 P-L) , 2912 Lapalma (1942 DM) , 20821 Balasridhar (2000 UT5) ,
- 481 Emita (1902 HP) , 11713 Stubbs (1998 HG51) , 1224 Fantasia (1927 SD) ,
- 3222 Liller (1983 NJ) , 35229 Benckert (1995 FY20) , 10982 Poerink (2672 T-3) ,
- 807 Ceraskia (1915 WY) , 5411 Liia (1973 AT3) , 4536 Drewpinsky (1987 DA6) ,
- 301 Bavaria , 6400 Georgealexander (1991 GQ1) , 16888 Michaelbarber (1998 BM26) ,
- 7504 Kawakita (1997 AF1) , 1477 Bonsdorffia (1938 CC) , 2333 Porthan (1943 EP) ,
- 21561 Masterman (1998 QR93) , 3515 Jindra (1982 UH2) , 32267 Hermannweyl (2000 PS1) ,
- 2582 Harimaya-Bashi (1981 SA) , 22933 Mareverett (1999 TZ141) , 8120 Kobe (1997 VT) ,
- 23019 Thomgregory (1999 VQ201) , 5027 Androgeos (1988 BX1) , 1428 Mombasa (1937 NO) ,
- 4771 Hayashi (1989 RM2) , 26276 Natrees (1998 SL4) , 6904 McGill (1990 QW1) ,
- 3378 Susanvictoria (A922 WB) , 6902 Hideoasada (1989 US3) , 7632 Stanislav (1982 UT5) ,
- 2022 West (1938 CK) , 18699 Quigley (1998 HL45) , 1932 Jansky (1971 UB1) ,
- 3887 Gerstner (1985 QX) , 8817 Roytraver (1985 JU1) , 16269 Merkord (2000 JP44) ,
- 1225 Ariane (1930 HK) , 10371 Gigli (1995 DU3) , 19612 Noordung (1999 OO) ,

- 9230 Yasuda (1996 YY2) , 8241 Agrius (1973 SE1) , 1304 Arosa (1928 KC) ,
 495 Eulalia (1902 KG) , 21001 Trogrlic (1987 GF) , 4734 Rameau (1982 UQ3) ,
 9298 Geake (1985 JM) , 5171 Augustesen (1987 SQ3) , 42981 Jenniskens (1999 TY224) ,
 35618 Tartu (1998 HC149) , 7197 Pieroangela (1994 BH) , 17683 Kanagawa (1997 AR16) ,
 14595 Peaker (1998 SW32) , 21357 Davidying (1997 FJ4) , 15898 Kharasterteam (1997 QP) ,
 2361 Gogol (1976 GQ1) , 8776 Campestris (2287 T-3) , 21558 Alisonliu (1998 QW77) ,
 7531 Pecorelli (1994 SC) , 2387 Xi'an (1975 FX) , 6773 Kellaway (1988 LK) ,
 3595 Gallagher (1985 TF1) , 23818 Matthewlepow (1998 QZ50) , 379 Huenna (1894 AQ) ,
 1568 Aisleen (1946 QB) , 2460 Mitlincoln (1980 TX4) , 4066 Haapavesi (1940 RG) ,
 4491 Otaru (1988 RP) , 17185 McDavid (1999 VU23) , 5286 Haruomukai (1989 VT1) ,
 24701 Elyu-Ene (1990 VY5) , 4773 Hayakawa (1989 WF) , 1564 Srbija (1936 TB) ,
 27977 Distratis (1997 UK5) , 18984 Olathe (2000 RA8) , 9383 Montelimar (1993 TP15) ,
 18883 Domegge (1999 YT8) , 4591 Bryantsev (1975 VZ) , 16589 Hastrup (1992 SL1) ,
 8907 Takaji (1995 WM5) , 1878 Hughes (1933 QC) , 7548 Engstrom (1980 FW2) ,
 6660 Matsumoto (1993 BC) , 4214 Veralynn (1987 UX4) , 4370 Dickens (1982 SL) ,
 21718 Cheonghapark (1999 RO115) , 12863 Whitfield (1998 KE48) , 172 Baucis ,
 5272 Dickinson (1981 QH2) , 43293 Banting (2000 GU1) , 715 Transvaalia (1911 LX) ,
 20187 Janapittichova (1997 AN17) , 4980 Magomaev (1974 SP1) , 20496 Jenik (1999 QA2) ,
 16221 Kevinyang (2000 DX48) , 4931 Tomsk (1983 CN3) , 9641 Demaziere (1994 PB30) ,
 24838 Abilunon (1995 UJ2) , 13653 Priscus (1997 CT16) , 2079 Jacchia (1976 DB) ,
 13667 Samthurman (1997 GT37) , 2792 Ponomarev (1977 EY1) , 3138 Ciney (1980 KL) ,
 6643 Morikubo (1990 VZ) , 2828 Iku-Turso (1942 DL) , 5211 Stevenson (1989 NX) ,
 16459 Barth (1989 WE4) , 18668 Gottesman (1998 FU62) , 7233 Majella (1986 EQ5) ,
 4425 Bilk (1967 UQ) , 24084 Teresaswiger (1999 TG289) , 3614 Tumilty (1983 AE1) ,
 20376 Joyhines (1998 KB44) , 8885 Sette (1994 EL3) , 4847 Amenhotep (6787 P-L) ,

- 17600 Dobrichovice (1995 SO) , 2701 Cherson (1978 RT) , 14621 Tati (1998 UF18) ,
13841 Blankenship (1999 XO32) , 7763 Crabeels (1990 UT5) , 9969 Braille (1992 KD) ,
27344 Veselvada (2000 DM2) , 3756 Ruscannon (1979 MV6) , 461 Saskia (1900 FP) ,
9156 Malanin (1982 TQ2) , 11098 Ginsberg (1995 GC2) , 1088 Mitaka (1927 WA) ,
4732 Froeschle (1981 JG) , 3128 Obruchev (1979 FJ2) , 723 Hammonia (1911 NB) ,
4344 Buxtehude (1988 CR1) , 6678 Seurat (3422 T-3) , 6041 Juterkilian (1990 KL) ,
3491 Fridolin (1984 SM4) , 2455 Somville (1950 TO4) , 11360 Formigine (1998 DL14) ,
1795 Woltjer (4010 P-L) , 6518 Vernon (1990 FR) , 7373 Stashis (1979 QX9) ,
16750 Marisandoz (1996 QL) , 5695 Remillieux (4577 P-L) , 11333 Forman (1996 HU) ,
12593 Shashlov (1999 RQ136) , 1535 Paijanne (1939 RC) , 20822 Lintingnien (2000 UK7) ,
17193 Alexeybaran (1999 XC205) , 8867 Tubbiolo (1992 BF4) , 6252 Montevideo (1992 EV11) ,
28766 Monge (2000 HP14) , 5010 Amenemhet (4594 P-L) , 32890 Schwob (1994 AL1) ,
10421 Dalmatin (1999 AY6) , 2620 Santana (1980 TN) , 3968 Koptelov (1978 TU5) ,
16267 McDermott (2000 JY43) , 1325 Inanda (1934 NR) , 134160 Pluis (2005 BE3) ,
21634 Huangweikang (1999 NB18) , 3372 Bratijchuk (1976 SP4) , 3086 Kalbaugh (1980 XE) ,
1277 Dolores (1933 HA) , 1718 Namibia (1942 RX) , 21250 Kamikouchi (1995 YQ2) ,
6060 Doudleby (1980 DX) , 8156 Tsukada (1988 TR) , 6870 Pauldavies (1992 OG) ,
1867 Deiphobus (1971 EA) , 5399 Awa (1989 BT) , 995 Sternberga (1923 NP) ,
3116 Goodricke (1983 CF) , 3829 Gunma (1988 EM) , 11696 Capen (1998 FD74) ,
15465 Buchroeder (1999 AZ5) , 1634 Ndola (1935 QP) , 2923 Schuyler (1977 DA) ,
13845 Jillburnett (1999 XL63) , 8887 Scheeres (1994 LK1) , 5541 Seimei (1976 UH16) ,
13221 Nao (1997 OY) , 4895 Embla (1986 TK4) , 653 Berenike (1907 BK) ,
11353 Guillaume (1997 XX5) , 21415 Nicobrenner (1998 FM70) , 3865 Lindblom (1988 AY4) ,
20585 Wentworth (1999 RG160) , 10213 Koukolik (1997 RK7) , 19008 Kristibutler (2000 RV70) ,
4727 Ravel (1979 UD1) , 23010 Kathyfinch (1999 VR158) , 14056 Kainar (1996 AO1) ,

- 22874 Haydeephelps (1999 RO197) , 1005 Arago (1923 OT) , 11719 Hicklen (1998 HT98) ,
6570 Tomohiro (1994 JO) , 8868 Hjorter (1992 EE7) , 2157 Ashbrook (A924 EF) ,
3450 Dommaget (1983 QJ) , 12976 Kalinenkov (1976 QK1) , 3512 Eriepa (1984 AC1) ,
6161 Vojno-Yasenetsky (1971 TY2) , 20618 Daniebutler (1999 SG7) , 9987 Peano (1997 OO1) ,
14124 Kamil (1998 QN60) , 8332 Ivantsvetaev (1982 TL2) , 16101 Notskas (1999 VA36) ,
652 Jubilatrix (1907 AU) , 23989 Farpoint (1999 RF) , 13285 Stephicks (1998 QK52) ,
2364 Seillier (1978 GD) , 1417 Walinska (1937 GH) , 2301 Whitford (1965 WJ) ,
4481 Herbelin (1985 RR) , 20580 Marlpeters (1999 RG151) , 6026 Xenophanes (1993 BA8) ,
357 Ninina (1893 J) , 277 Elvira , 23248 Batchelor (2000 WW178) , 11341 Babbage (1996 XE2) ,
5108 Lubeck (1987 QG2) , 14902 Miyairi (1993 BE2) , 26986 Caslavská (1997 VC5) ,
545 Messalina (1904 OY) , 21450 Kissel (1998 HD23) , 7265 Edithmuller (2908 T-2) ,
15199 Rodnyanskaya (1974 SE) , 15614 Pillinger (2000 GA143) , 10591 Caverni (1996 PD3) ,
6720 Gifu (1990 VP2) , 8062 Okhotsymskij (1977 EZ) , 6571 Sigmund (3027 P-L) ,
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16244 Broz (2000 GQ147) , 23325 Arroyo (2001 BK30) , 1180 Rita (1931 GE) ,
6050 Miwablock (1992 AE) , 1828 Kashirina (1966 PH) , 19994 Tresini (1990 TJ15) ,
18954 Sarahbounds (2000 QT119) , 4082 Swann (1984 SW3) , 7994 Bethellen (1983 CQ2) ,
13479 Vet (1977 TO6) , 16265 Lemay (2000 JL43) , 7675 Gorizia (1995 WT5) ,
2419 Moldavia (1974 SJ) , 3021 Lucubratio (1967 CB) , 15376 Martak (1997 CT1) ,
21505 Bernert (1998 KG28) , 5183 Robyn (1990 OA1) , 8775 Cristata (5490 T-2) ,
5160 Camoes (1979 YO) , 6330 Koen (1992 FN) , 3206 Wuhan (1980 VN1) ,
12433 Barbieri (1996 AF4) , 4208 Kiselev (1986 RQ2) , 13806 Darmstrong (1998 XM6) ,
14318 Buzinov (1978 SD3) , 1023 Thomana (1924 RU) , 7549 Woodard (1980 TO5) ,
21653 Davidwang (1999 OH3) , 4625 Shchedrin (1982 UG6) , 10793 Quito (1992 CU2) ,
21547 Kottapalli (1998 QK38) , 9854 Karlheinz (1991 AC3) , 6487 Tonyspear (1991 GA1) ,

- 3983 Sakiko (1984 SX) , 6078 Burt (1980 TC5) , 11315 Salpetriere (1994 NS1) ,
4334 Foo (1983 RO3) , 7258 Pettarin (1994 EF) , 6183 Viscome (1987 SF7) ,
11690 Carodulaney (1998 FV60) , 7220 Philnicholson (1981 QE) , 9493 Enescu (3100 T-1) ,
4869 Piotrovsky (1989 UE8) , 11084 Gio (1993 SG3) , 5705 Ericsterken (1965 UA) ,
18556 Battiato (1997 CC7) , 812 Adele (1915 XV) , 22836 Leeannragasa (1999 RH89) ,
2613 Plzen (1979 QE) , 11422 Alilienthal (1999 LD7) , 9306 Pittosporum (1987 CG) ,
18236 Bernardburke (1059 T-2) , 11766 Fredseares (9073 P-L) , 29148 Palzer (1988 JE) ,
11374 Briantaylor (1998 QU60) , 14395 Tommorgan (1990 TN3) , 11756 Geneparker (2779 P-L) ,
4498 Shinkoyama (1989 AG1) , 4934 Rhoneranger (1985 JJ) , 2774 Tenojoki (1942 TJ) ,
18160 Nihon Uchu Forum (2000 PY12) , 1430 Somalia (1937 NK) , 3562 Ignatius (1984 AZ) ,
2531 Cambridge (1980 LD) , 29133 Vargas (1987 KH5) , 11203 Danielbetten (1999 FV26) ,
3162 Nostalgia (1980 YH) , 8330 Fitzroy (1982 FX3) , 20634 Marichardson (1999 TP94) ,
1572 Posnania (1949 SC) , 4722 Agelaos (4271 T-3) , 11274 Castillo-Rogez (1988 SX2) ,
42747 Fuser (1998 SU10) , 3941 Haydn (1973 UU5) , 7434 Osaka (1994 AB3) ,
6189 Volk (1989 EY2) , 6516 Gruss (1988 TC2) , 19531 Charton (1999 GM32) ,
2789 Foshan (1956 XA) , 1826 Miller (1955 RC1) , 20768 Langberg (2000 QO54) ,
1930 Lucifer (1964 UA) , 9100 Tomohisa (1996 XU1) , 11149 Tateshina (1997 XZ9) ,
7362 Rogerbyrd (1996 EY) , 7223 Dolgorukij (1982 TF2) , 9263 Khariton (1976 SX5) ,
14158 Alananderson (1998 SZ133) , 1072 Malva (1926 TA) , 23587 Abukumado (1995 TE8) ,
11581 Philipdejager (1994 PK9) , 12218 Fleischer (1982 RK) , 295 Theresia ,
19993 Gunterseeber (1990 TK10) , 20037 Duke (1992 UW4) , 3973 Ogilvie (1981 UC1) ,
475 Ocllo (1901 HN) , 11377 Nye (1998 SH59) , 19484 Vanessaspini (1998 HF121) ,
675 Ludmilla (1908 DU) , 12139 Tomcowling (4055 P-L) , 6962 Summerscience (1990 OT) ,
4865 Sor (1988 UJ) , 3976 Lise (1983 JM) , 1365 Henyey (1928 RK) ,
9780 Bandersnatch (1994 SB) , 4647 Syuji (1931 TU1) , 2709 Sagan (1982 FH) ,

- 2648 Owa (1980 VJ) , 7802 Takiguchi (1996 XG1) , 1742 Schaifers (1934 RO) ,
5612 Nevskij (1975 TX2) , 3186 Manuilova (1973 SD3) , 9144 Hollisjohnson (1955 UN1) ,
4774 Hobetsu (1991 CV1) , 15818 DeVeny (1994 RO7) , 249 Ilse ,
9262 Bordovitsyna (1973 RF) , 15957 Gemoore (1998 BB27) , 8933 Kurobe (1997 AU6) ,
22628 Michaelallen (1998 KV39) , 7049 Meibom (1981 UV21) , 5904 Wurttemberg (1989 AE7) ,
464 Megaira (1901 FV) , 2193 Jackson (1926 KB) , 15282 Franzmarc (1991 RX4) ,
17652 Nepoti (1996 VQ1) , 697 Galilea (1910 JO) , 4369 Seifert (1982 OR) ,
12465 Perth Amboy (1997 AD10) , 16107 Chanmugam (1999 WQ2) , 4515 Khrennikov (1973 SD6) ,
14570 Burkam (1998 QS37) , 6705 Rinaketty (1988 RK5) , 9143 Burkhead (1955 SF) ,
2349 Kurchenko (1970 OG) , 5049 Sherlock (1981 VC1) , 3984 Chacos (1984 SB6) ,
23153 Andrewnowell (2000 CH46) , 22530 Huynh-Le (1998 FY41) , 14438 MacLean (1992 HC2) ,
12596 Shukla (1999 RT154) , 18779 Hattyhong (1999 JN44) , 18838 Shannon (1999 OQ) ,
12519 Pullen (1998 HH55) , 1239 Queteleta (1932 CB) , 4871 Riverside (1989 WH1) ,
2971 Mohr (1980 YL) , 6422 Akagi (1994 CD1) , 3024 Hainan (1981 UW9) ,
5402 Kejosmith (1989 UK2) , 17279 Jeniferevans (2000 LX27) , 6602 Gilclark (1989 EC) ,
614 Pia (1906 VQ) , 11118 Modra (1996 PK) , 22603 Davidoconnor (1998 HK133) ,
27975 Mazurkiewicz (1997 UJ1) , 11251 Icarion (1973 SN1) , 38976 Taeve (2000 UR) ,
18656 Mergler (1998 FW29) , 3567 Alvema (1930 VD) , 2679 Kittisvaara (1939 TG) ,
10616 Inouetakeshi (1997 UW8) , 7811 Zhaojiuzhang (1982 DT6) , 4002 Shinagawa (1950 JB) ,
5020 Asimov (1981 EX19) , 11826 Yurijgromov (1982 UR10) , 3833 Calingasta (1971 SC) ,
36672 Sidi (2000 QR220) , 5124 Muraoka (1989 CW) , 1575 Winifred (1950 HH) ,
20289 Nettimi (1998 FQ64) , 3896 Pordenone (1987 WB) , 9123 Yoshiko (1998 FQ11) ,
12926 Brianmason (1999 SO9) , 20861 Lesliebeh (2000 VX34) , 8822 Shuryanka (1987 RQ2) ,
166 Rhodope , 9535 Plitchenko (1981 UO11) , 42377 KLENOT (2002 EU2) ,
11928 Akimotohiro (1993 BT2) , 20140 Costitx (1996 QT1) , 15566 Elizabethbaker (2000 GD50) ,

- 75 Eurydike , 2155 Wodan (6542 P-L) , 6127 Hetherington (1989 HD) ,
16150 Clinch (1999 XZ227) , 7489 Oribe (1995 MX) , 12861 Wacker (1998 KW33) ,
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- 20557 Davidkulka (1999 RB116) , 5584 Izenberg (1989 KK) , 533 Sara (1904 NZ) ,
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Normalize and then average the daily article count across all individual minor planets

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Check whether dates are sampled regularly day by day and check number of dates

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Out[1]= True
```

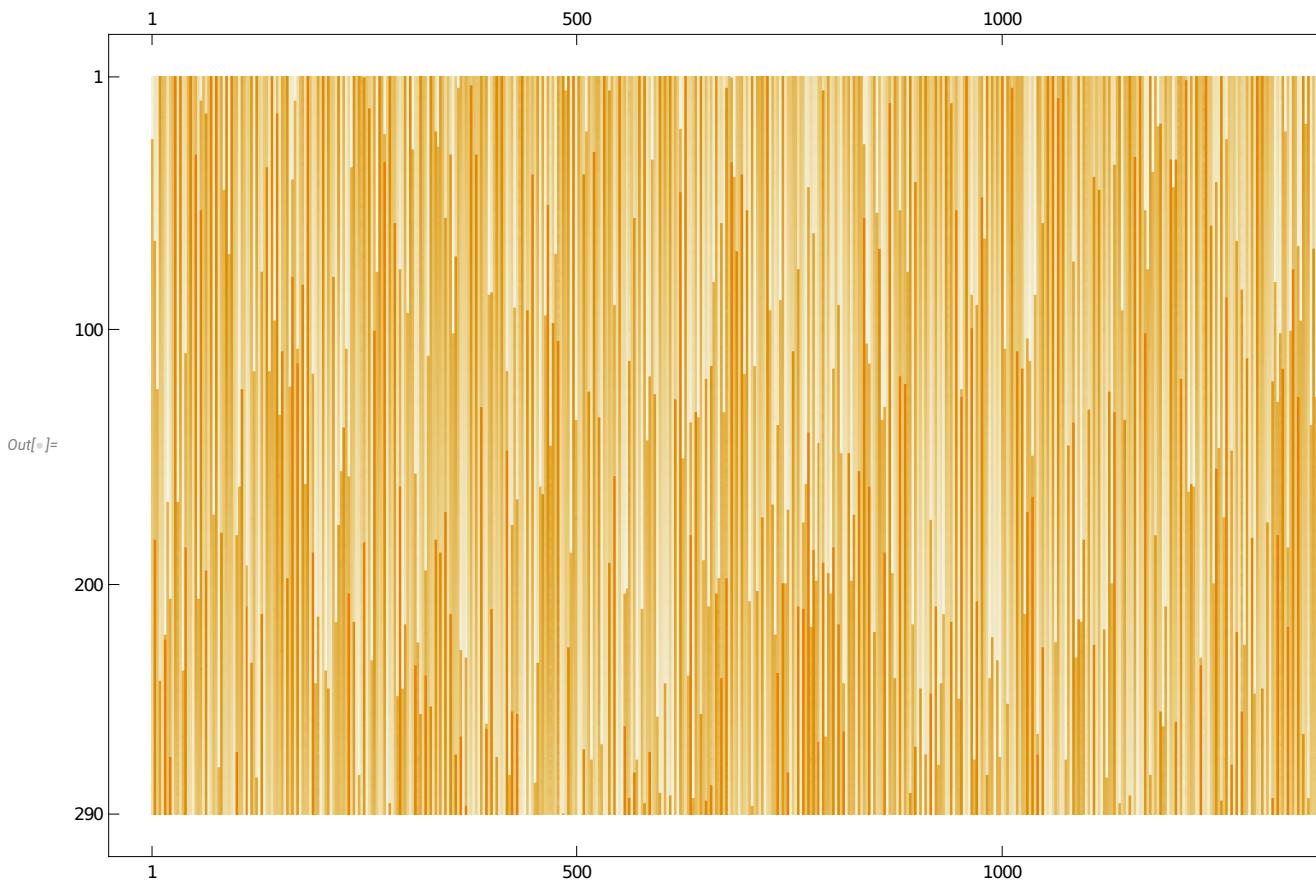
```
In[2]:= Length[dates]
```

```
Out[2]= 290
```

Extract Article Counts and Angles of Namesakes to Sun in Radians

```
In[®]:= toanalyse = sundata[[2 ;; All, 2 ;; All]];
In[®]:= toanalyse[[All, -1]]
Out[®]= {150.7, 149.48, 148.27, 147.06, 145.86, 144.67, 143.48, 142.3, 141.13, 139.96, 138.8,
137.65, 136.51, 135.37, 134.24, 133.12, 132.01, 130.9, 129.8, 128.71, 127.63,
126.55, 125.49, 124.43, 123.38, 122.33, 121.29, 120.31, 119.29, 118.27, 117.27,
116.27, 115.28, 114.29, 113.31, 112.34, 111.38, 110.42, 109.47, 108.53, 107.59,
106.66, 105.73, 104.82, 103.91, 103., 102.1, 101.21, 100.33, 99.45, 98.57,
97.7, 96.84, 95.99, 95.13, 94.29, 93.45, 92.617, 91.79, 90.96, 90.15, 89.33,
88.52, 87.72, 86.92, 86.13, 85.34, 84.55, 83.77, 83., 82.23, 81.46, 80.7, 79.94,
79.18, 78.43, 77.69, 76.94, 76.2, 75.47, 74.74, 74.01, 73.29, 72.57, 71.85,
71.14, 70.43, 69.72, 69.02, 68.32, 67.62, 66.93, 66.24, 65.55, 64.87, 64.18,
63.5, 62.83, 62.15, 61.48, 60.82, 60.15, 59.49, 58.82, 58.17, 57.51, 56.86,
56.21, 55.56, 54.91, 54.27, 53.62, 52.98, 52.35, 51.71, 51.08, 50.44, 49.81,
49.19, 48.56, 47.94, 47.32, 46.69, 46.08, 45.46, 44.84, 44.23, 43.61, 43.,
42.39, 41.78, 41.18, 40.57, 39.97, 39.36, 38.76, 38.16, 37.56, 36.97, 36.37,
35.77, 35.18, 34.59, 34., 33.4, 32.81, 32.23, 31.64, 31.05, 30.47, 29.88, 29.3,
28.71, 28.13, 27.55, 26.97, 26.39, 25.81, 25.23, 24.65, 24.07, 23.5, 22.92,
22.34, 21.77, 21.19, 20.62, 20.05, 19.47, 18.9, 18.33, 17.75, 17.18, 16.61,
16.04, 15.47, 14.9, 14.33, 13.76, 13.19, 12.62, 12.05, 11.49, 10.92, 10.35,
9.78, 9.21, 8.64, 8.08, 7.51, 6.94, 6.37, 5.8, 5.23, 4.66, 4.1, 3.53, 2.96, 2.39,
1.82, 1.25, 0.68, 0.11, 359.54, 358.98, 358.41, 357.84, 357.27, 356.7, 356.12,
355.55, 354.98, 354.41, 353.84, 353.26, 352.69, 352.12, 351.54, 350.97, 350.39,
349.82, 349.24, 348.67, 348.09, 347.51, 346.93, 346.35, 345.77, 345.19, 344.61,
344.03, 343.45, 342.87, 342.29, 341.7, 341.12, 340.53, 339.95, 339.36, 338.78,
338.19, 337.6, 337.01, 336.42, 335.83, 335.24, 334.64, 334.05, 333.45, 332.86,
332.26, 331.66, 331.06, 330.46, 329.86, 329.26, 328.66, 328.05, 327.45, 326.84,
326.24, 325.63, 325.02, 324.41, 323.8, 323.16, 322.55, 321.93, 321.32, 320.7,
320.08, 319.46, 318.84, 318.22, 317.59, 316.97, 316.34, 315.71, 315.08, 314.45,
313.82, 313.19, 312.55, 311.92, 311.28, 310.64, 310., 309.35, 308.71, 308.06}
```

```
In[1]:= MatrixPlot[toanalyse]
```



```
In[2]:= articles = Table[toanalyse[[All, i]], {i, 1, Length[toanalyse[[1]]], 2}];
```

```
In[3]:= anglesrads =
  Table[UnitConvert[Quantity[toanalyse[[All, i]], "AngularDegrees"], "Radians"],
    {i, 2, Length[toanalyse[[1]]], 2}];
```

```
In[4]:= Length[articles[[1]]]
```

```
Out[4]= 290
```

```
In[5]:= Length[anglesrads[[1]]]
```

```
Out[5]= 290
```

For Each Minor Planet Studied, Construct Time Series for the Normalized Article Counts

```
In[6]:= articlesTS = Table[TimeSeries[articles[[i]], {dates}], {i, 1, Length[articles]}];
```

```
In[7]:= normarticlesTS = Table[Normalize[articlesTS[[i]]], {i, 1, Length[articlesTS]}];
```

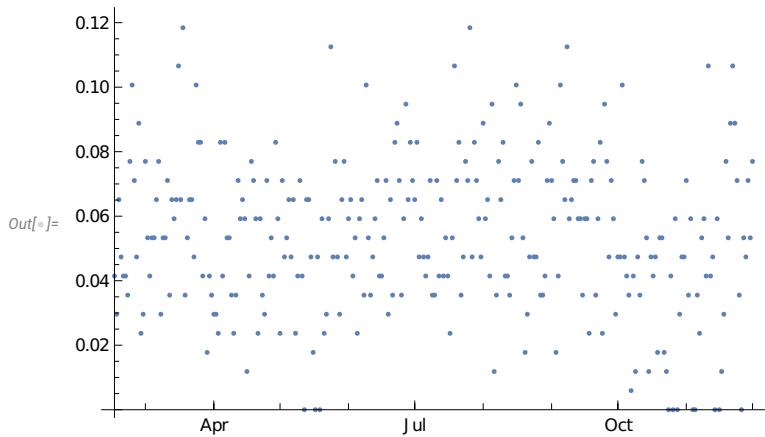
Look at an Example, the Second One, for a Time Series of the Number of Articles

Per Day

```
In[1]:= normarticlesTS[[2]]
```

```
Out[1]= TimeSeries[  Time: 15 Feb 2022 to 01 Dec 2022 ]  
Data points: 290
```

```
In[2]:= ListPlot[%]
```



```
In[3]:= Mod[0, 360]
```

```
Out[3]= 0
```

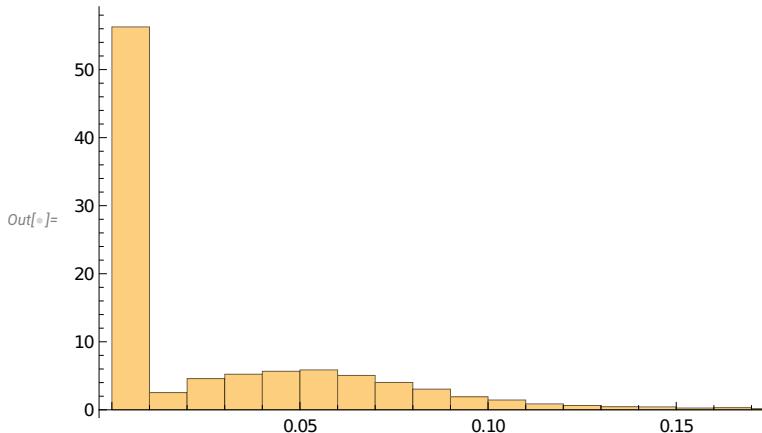
Similarly, Construct a Time Series for the Rounded Angular Degrees to the Sun for Each Minor Planet

```
In[4]:= anglesTS = Table[TimeSeries[UnitConvert[anglesrads[[i]], "AngularDegrees"], {dates}],  
{i, 1, Length[anglesrads]}];
```

```
In[5]:= justangles = Flatten[Table[  
    Mod[Round[QuantityMagnitude[Values[anglesTS[[i]]]]], 360], {i, 1, Length[anglesTS]}]];
```

```
In[6]:= justvalues = Flatten[Table[Values[normarticlesTS[[i]]], {i, Length[normarticlesTS]}]];
```

```
In[®]:= Histogram[justvalues, Automatic, "ProbabilityDensity"]
```



Now, combine angles and article counts.

```
In[®]:= just = Transpose[{justangles, justvalues}];  
In[®]:= Length[just] (*this is the number of data points to date*)  
Out[®]= 351190
```

Do some basic descriptive statistics. Some will be used for calculating sampling errors.

```
In[®]:= Length[dates]*Length[articles](*confirmation of number of data points*)  
Out[®]= 351190
```

```
In[®]:= tsNA4Lengths = KeySort[GroupBy[just, First → Last, Length]];  
In[®]:= tsNA4SD = KeySort[GroupBy[just, First → Last, StandardDeviation]];  
In[®]:= samplingerrors = 1.95 * N[Values[tsNA4SD]] / Values[tsNA4Lengths];  
In[®]:= Mean[samplingerrors]  
Out[®]= 0.000102675  
  
In[®]:= N[Mean[justvalues]]  
Out[®]= 0.0289967  
  
In[®]:= Mean[samplingerrors] / N[Mean[justvalues]]  
Out[®]= 0.00354092
```

Calculate the average normalized article count per rounded degree.

```
In[®]:= valgrpbydeg = KeySort[GroupBy[N[just], First → Last, Mean]]  
Out[®]= <| 0. → 0.0284361, 1. → 0.0290893, 2. → 0.0284982, 3. → 0.0293737, 4. → 0.028419,  
5. → 0.0297311, 6. → 0.0278757, 7. → 0.0306673, 8. → 0.0308112, 9. → 0.0276028,
```

10. → 0.0269094, 11. → 0.0308375, 12. → 0.0321638, 13. → 0.0297927, 14. → 0.0288552,
15. → 0.027427, 16. → 0.0283326, 17. → 0.0281379, 18. → 0.0302212, 19. → 0.029665,
20. → 0.0293942, 21. → 0.0279263, 22. → 0.0310809, 23. → 0.0300927, 24. → 0.0272368,
25. → 0.0296532, 26. → 0.0294515, 27. → 0.0286947, 28. → 0.0313297, 29. → 0.0292557,
30. → 0.0306916, 31. → 0.0307711, 32. → 0.0292105, 33. → 0.028044, 34. → 0.0312456,
35. → 0.0287522, 36. → 0.0280377, 37. → 0.0310129, 38. → 0.0284394, 39. → 0.0298188,
40. → 0.0306607, 41. → 0.0289329, 42. → 0.0303357, 43. → 0.0314249, 44. → 0.0303757,
45. → 0.0290256, 46. → 0.028603, 47. → 0.0298134, 48. → 0.0296852, 49. → 0.0294014,
50. → 0.0317037, 51. → 0.029522, 52. → 0.0289287, 53. → 0.0297509, 54. → 0.0305606,
55. → 0.0304917, 56. → 0.0304189, 57. → 0.0296792, 58. → 0.0303074, 59. → 0.0296908,
60. → 0.0283368, 61. → 0.0294147, 62. → 0.0287021, 63. → 0.0295248, 64. → 0.0274711,
65. → 0.0287618, 66. → 0.0291229, 67. → 0.0288768, 68. → 0.028245, 69. → 0.0320116,
70. → 0.031512, 71. → 0.0321461, 72. → 0.029459, 73. → 0.0294999, 74. → 0.031489,
75. → 0.0298521, 76. → 0.0326921, 77. → 0.028714, 78. → 0.031653, 79. → 0.0282272,
80. → 0.0306484, 81. → 0.0306817, 82. → 0.032144, 83. → 0.0328643, 84. → 0.0286152,
85. → 0.0299095, 86. → 0.02865, 87. → 0.0308226, 88. → 0.0295827, 89. → 0.0302089,
90. → 0.0279134, 91. → 0.0310025, 92. → 0.0307556, 93. → 0.0286746, 94. → 0.0294689,
95. → 0.0308359, 96. → 0.0307293, 97. → 0.0299506, 98. → 0.0300688, 99. → 0.0296063,
100. → 0.0274996, 101. → 0.0284756, 102. → 0.0270589, 103. → 0.0330454,
104. → 0.030539, 105. → 0.0311115, 106. → 0.029443, 107. → 0.0280583,
108. → 0.0267966, 109. → 0.0314749, 110. → 0.0299161, 111. → 0.0282708,
112. → 0.0288016, 113. → 0.0295221, 114. → 0.0287761, 115. → 0.0274223,
116. → 0.0312549, 117. → 0.0319803, 118. → 0.0300784, 119. → 0.0292927,
120. → 0.0294041, 121. → 0.0292671, 122. → 0.0288477, 123. → 0.0292154,
124. → 0.0288835, 125. → 0.0314527, 126. → 0.0334092, 127. → 0.0269377,
128. → 0.0274382, 129. → 0.0269577, 130. → 0.0288843, 131. → 0.0292987,
132. → 0.0295127, 133. → 0.0308645, 134. → 0.0269208, 135. → 0.0268655,
136. → 0.0270826, 137. → 0.031325, 138. → 0.030364, 139. → 0.0283301,
140. → 0.0318948, 141. → 0.0304712, 142. → 0.0300741, 143. → 0.0314799,
144. → 0.0300229, 145. → 0.0299988, 146. → 0.0300871, 147. → 0.0298355,
148. → 0.0292753, 149. → 0.0283649, 150. → 0.026969, 151. → 0.0264639,
152. → 0.0293044, 153. → 0.0320098, 154. → 0.0286707, 155. → 0.02791,
156. → 0.0299448, 157. → 0.0280975, 158. → 0.0262646, 159. → 0.0291987,
160. → 0.0292362, 161. → 0.0279413, 162. → 0.0293459, 163. → 0.0311227,
164. → 0.0319408, 165. → 0.0269473, 166. → 0.0272084, 167. → 0.0268916,
168. → 0.0319791, 169. → 0.0304849, 170. → 0.0316307, 171. → 0.0279149,
172. → 0.0290444, 173. → 0.0272187, 174. → 0.0284902, 175. → 0.0296621,
176. → 0.0298022, 177. → 0.0259906, 178. → 0.0304092, 179. → 0.0285847,
180. → 0.0289238, 181. → 0.0274401, 182. → 0.0266201, 183. → 0.0284474,
184. → 0.0251996, 185. → 0.0260894, 186. → 0.0264054, 187. → 0.0280166,
188. → 0.0263082, 189. → 0.0280608, 190. → 0.0282637, 191. → 0.028721,
192. → 0.0267842, 193. → 0.0284708, 194. → 0.0282039, 195. → 0.0310513,
196. → 0.0306831, 197. → 0.0256274, 198. → 0.0299744, 199. → 0.0302392,

200. → 0.028411, 201. → 0.0268921, 202. → 0.0282876, 203. → 0.0272309,
 204. → 0.0295187, 205. → 0.0284311, 206. → 0.0292189, 207. → 0.030888,
 208. → 0.0295172, 209. → 0.0283526, 210. → 0.029131, 211. → 0.0271801,
 212. → 0.0272456, 213. → 0.0268709, 214. → 0.0241725, 215. → 0.0288412,
 216. → 0.0308484, 217. → 0.0272023, 218. → 0.0309978, 219. → 0.0258413,
 220. → 0.0265129, 221. → 0.025288, 222. → 0.0284406, 223. → 0.030887,
 224. → 0.0285126, 225. → 0.030241, 226. → 0.0305301, 227. → 0.0277015,
 228. → 0.0283182, 229. → 0.0254561, 230. → 0.026178, 231. → 0.0289057,
 232. → 0.0275169, 233. → 0.0265631, 234. → 0.0282146, 235. → 0.0281343,
 236. → 0.0257354, 237. → 0.0257867, 238. → 0.0275971, 239. → 0.0305003,
 240. → 0.0250887, 241. → 0.0286367, 242. → 0.0275837, 243. → 0.0299809,
 244. → 0.0269191, 245. → 0.0271232, 246. → 0.0278081, 247. → 0.0250176,
 248. → 0.0263104, 249. → 0.0281071, 250. → 0.0273854, 251. → 0.0271193,
 252. → 0.0274228, 253. → 0.0270848, 254. → 0.028575, 255. → 0.0261792,
 256. → 0.0289222, 257. → 0.0286117, 258. → 0.0299716, 259. → 0.0265347,
 260. → 0.0257538, 261. → 0.0293858, 262. → 0.0278307, 263. → 0.0287447,
 264. → 0.02518, 265. → 0.0287814, 266. → 0.0275533, 267. → 0.0271049,
 268. → 0.0260446, 269. → 0.0312786, 270. → 0.0289664, 271. → 0.0289098,
 272. → 0.0286249, 273. → 0.0284162, 274. → 0.028047, 275. → 0.0298645,
 276. → 0.0305565, 277. → 0.0290134, 278. → 0.0257437, 279. → 0.0283821,
 280. → 0.0285765, 281. → 0.0270962, 282. → 0.0270562, 283. → 0.030112,
 284. → 0.0307197, 285. → 0.0281179, 286. → 0.0280355, 287. → 0.0284853,
 288. → 0.0297356, 289. → 0.0272311, 290. → 0.0292573, 291. → 0.0298684,
 292. → 0.0282791, 293. → 0.0298311, 294. → 0.030991, 295. → 0.0263123,
 296. → 0.0301516, 297. → 0.0270942, 298. → 0.0260118, 299. → 0.0269904,
 300. → 0.0272282, 301. → 0.0312433, 302. → 0.0302584, 303. → 0.0277386,
 304. → 0.0306288, 305. → 0.0316165, 306. → 0.030213, 307. → 0.0285528,
 308. → 0.0275391, 309. → 0.0298418, 310. → 0.0297673, 311. → 0.0296744,
 312. → 0.0261693, 313. → 0.0291788, 314. → 0.0286164, 315. → 0.0295502,
 316. → 0.0310366, 317. → 0.0279183, 318. → 0.0297483, 319. → 0.0275803,
 320. → 0.0275507, 321. → 0.0296945, 322. → 0.0291077, 323. → 0.0285463,
 324. → 0.0278181, 325. → 0.0266653, 326. → 0.0269128, 327. → 0.0277101,
 328. → 0.0284481, 329. → 0.0287905, 330. → 0.0285282, 331. → 0.0265334,
 332. → 0.0276891, 333. → 0.0284252, 334. → 0.0294637, 335. → 0.0271685,
 336. → 0.0268438, 337. → 0.0294862, 338. → 0.0287769, 339. → 0.0281955,
 340. → 0.0305408, 341. → 0.0292695, 342. → 0.0287522, 343. → 0.0282718,
 344. → 0.0277104, 345. → 0.0294102, 346. → 0.0305477, 347. → 0.0280443,
 348. → 0.0272991, 349. → 0.0287844, 350. → 0.0301981, 351. → 0.0297668,
 352. → 0.028636, 353. → 0.0297227, 354. → 0.0295994, 355. → 0.0305125,
 356. → 0.0316617, 357. → 0.0309546, 358. → 0.0291947, 359. → 0.0291727 |>

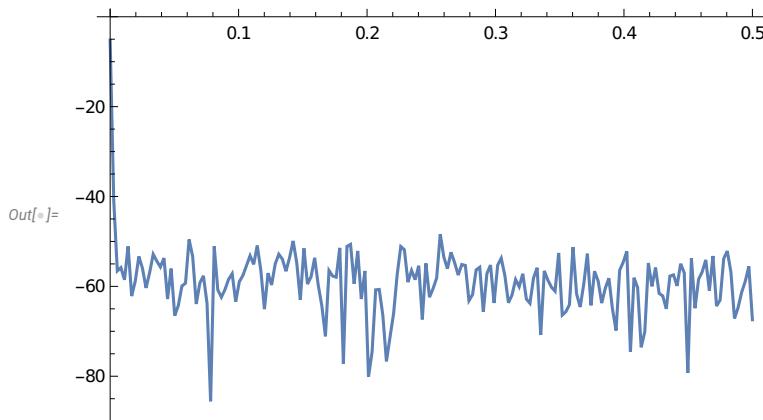
In[8]:= **data = Values[valgrpbydeg];**

```
In[=]:= sd = StandardDeviation[data]
```

```
Out[=]= 0.0016409
```

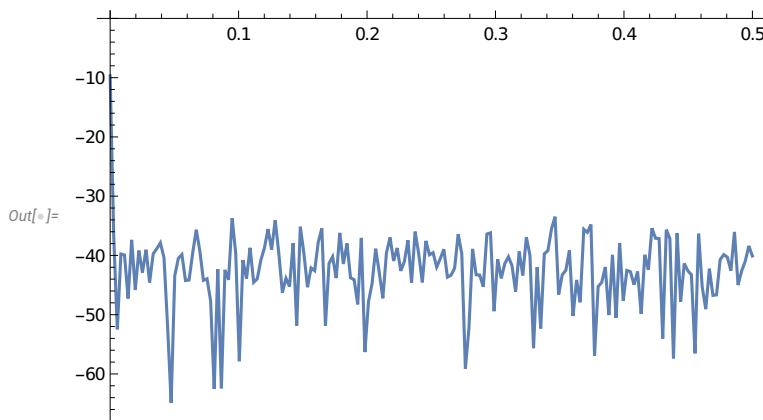
A periodogram is useful for seeing periodicities in the data.

```
In[=]:= Periodogram[data, PlotRange -> All]
```



Compare to a random simulation to see some idea of unusual behavior.

```
In[=]:= Periodogram[RandomReal[Max[data], 360], PlotRange -> All]
```



There is a peak at 2 and 3. Let's get more particular about pulling out one Fourier Transform peak at 30. It corresponds to a frequency of ~12, i.e. this may be same basis as for the astrology signs. Also, there is an even stronger signal at 93, corresponding to a frequency of ~4. This may be the basis for squares.

```
In[=]:= Length[data]
```

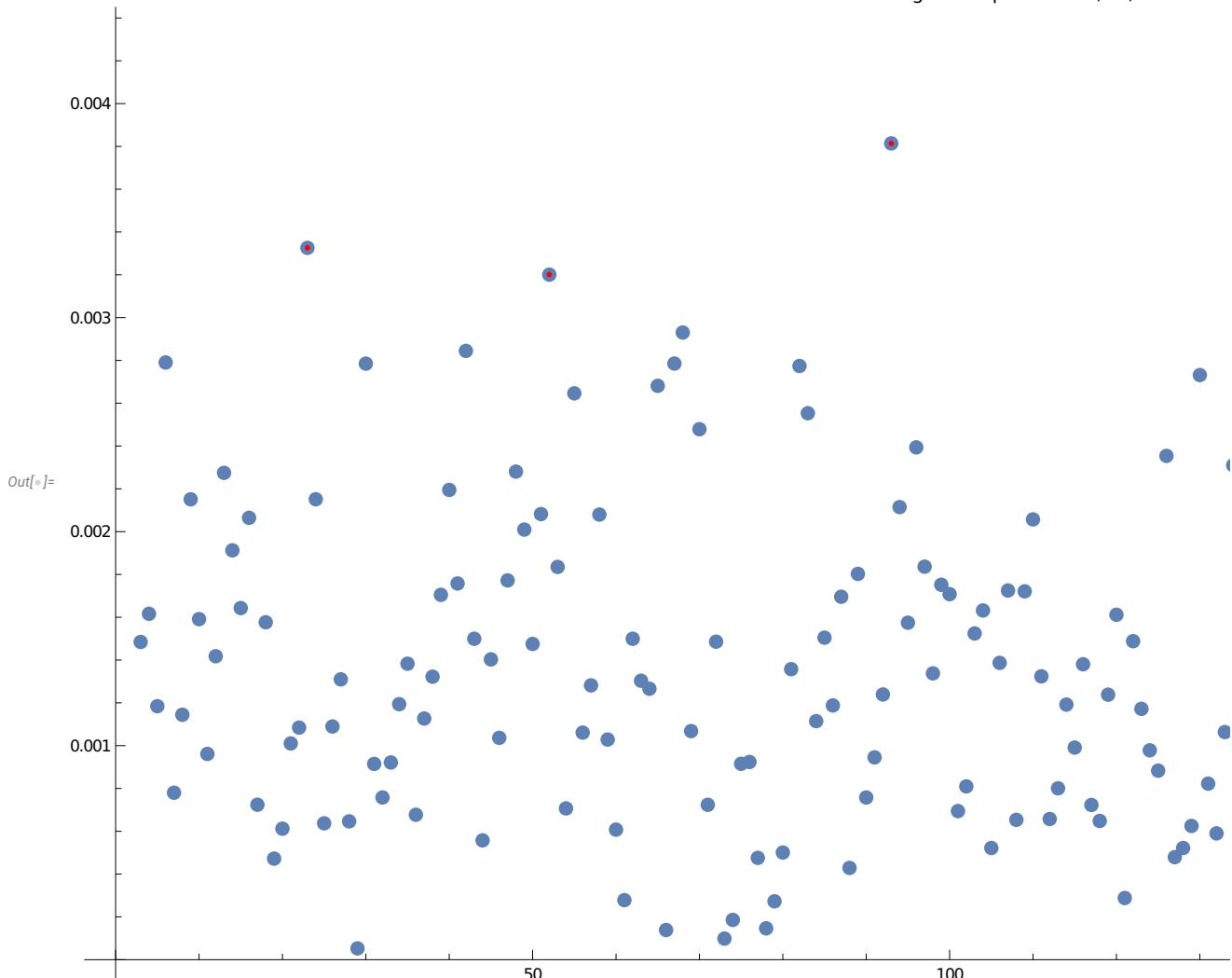
```
Out[=]= 360
```

```
In[1]:= f = Abs[Fourier[data]];
peaksize = Last[TakeLargest[f, 8]];
peaks = Flatten[Position[f, x_ /; x ≥ peaksize]]
```

```
Out[1]= {1, 2, 23, 52, 93, 269, 310, 339, 360}
```

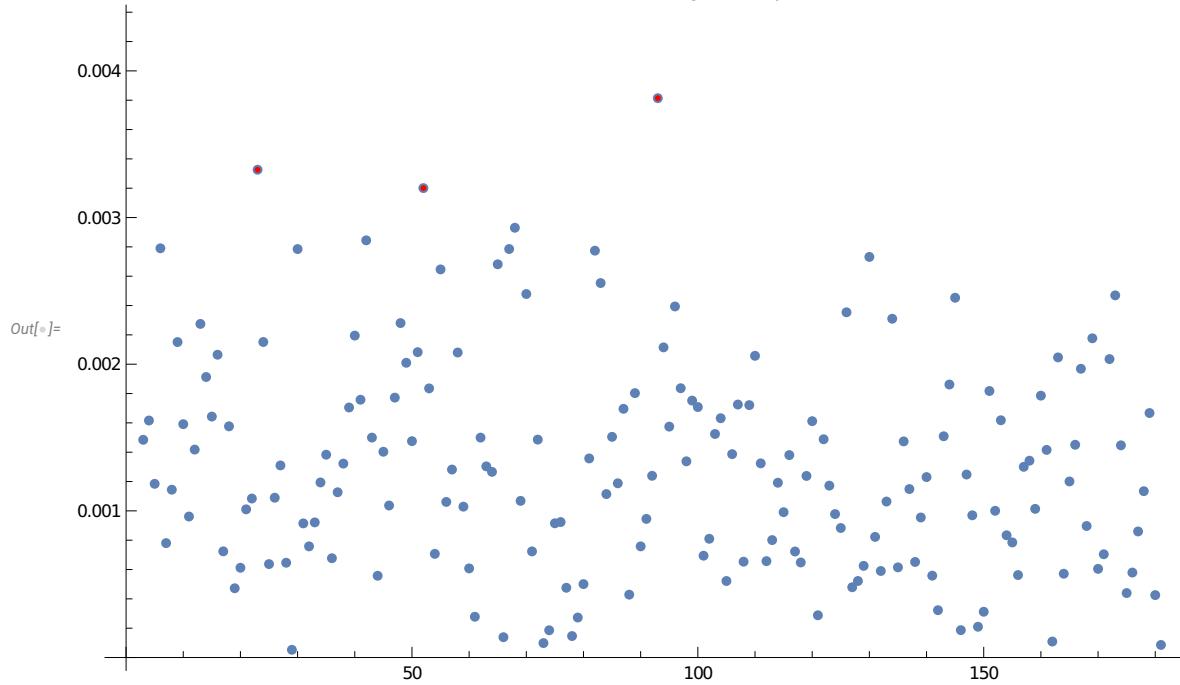
```
In[2]:= Show[ListPlot[f[[1 ;; 181]],
PlotLabel → "Discrete Fourier Transform of Data Have Highest
Amplitude at 93, 23, and 52"],
Graphics[{Red, Point[{93, f[[93]]}], Point[{23, f[[23]]}], Point[{52, f[[52]]}]}]]
```

Discrete Fourier Transform of Data Have Highest Amplitude at 93, 23, and 52



```
In[]:= Show[% , ImageSize → Large]
```

Discrete Fourier Transform of Data Have Highest Amplitude at 93, 23, and 52

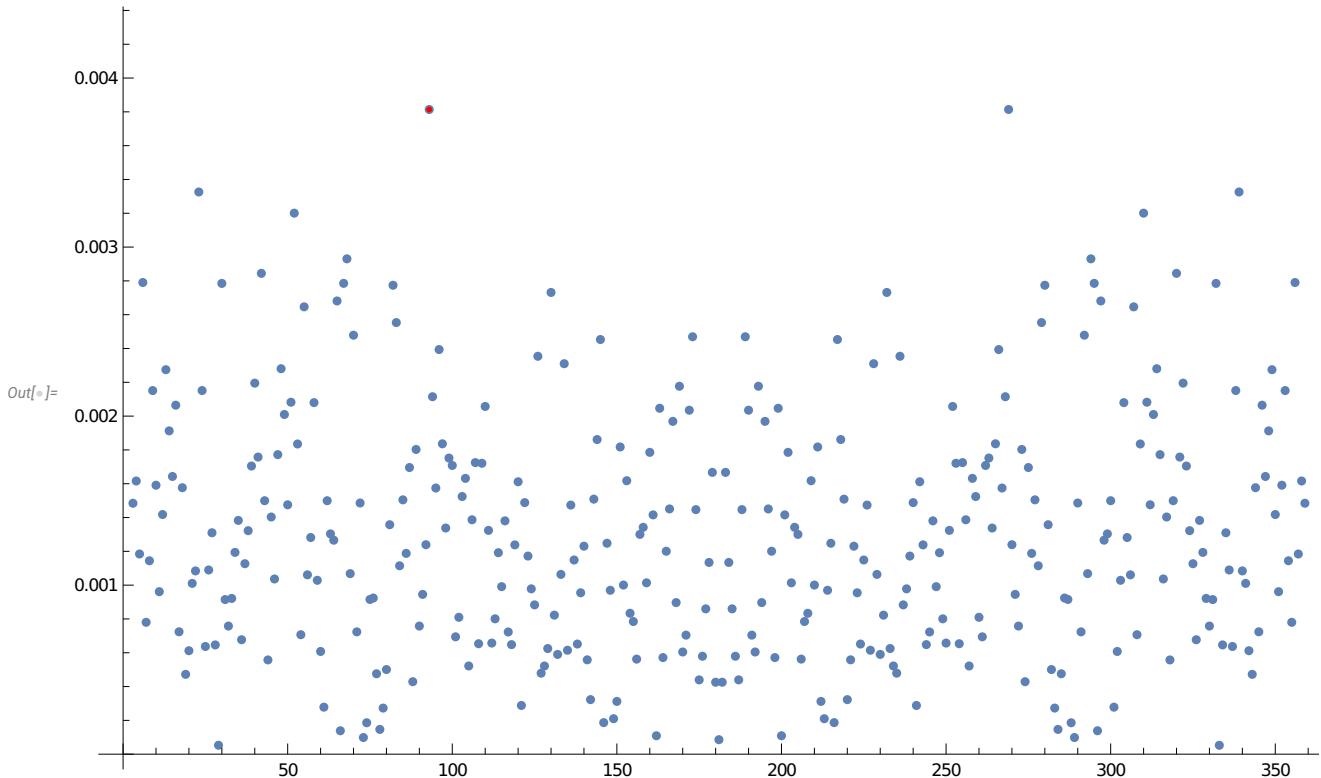


```
In[]:= pos1 = 93;
```

```
In[]:= pos1
```

```
Out[]= 93
```

```
In[1]:= Show[ListPlot[f(*, PlotRange→All*)], Graphics[{Red, Point[{pos1, f[pos1]}]}]]
```

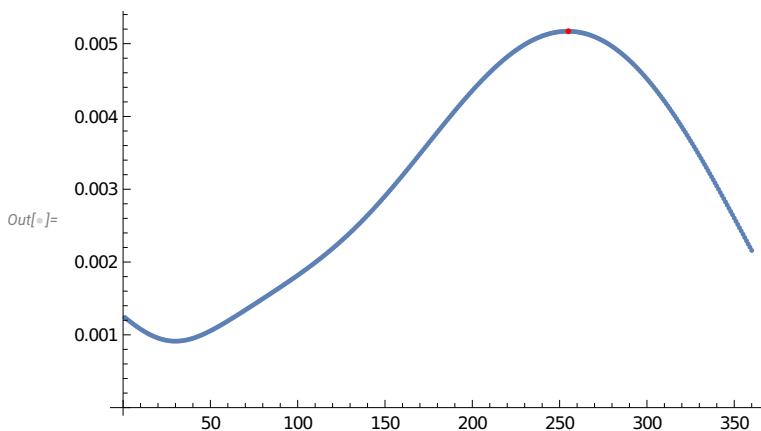


```
In[2]:= n = 360;
```

```
In[3]:= fr1 = Abs[Fourier[
  data * Exp[2 Pi I (pos1 - 2) N[Range[0, n - 1]] / n], FourierParameters → {0, 2/n}]];
frpos1 = Position[fr1, Max[fr1]][[1, 1]]
```

```
Out[3]= 255
```

```
In[4]:= Show[ListPlot[fr1], Graphics[{Red, Point[{frpos1, fr1[[frpos1]]}]}], PlotRange → All]
```



```

In[]:= N[n / (pos1 - 2 + 2 (frpos1 - 1) / n)](*period*)
Out[]= 3.89564

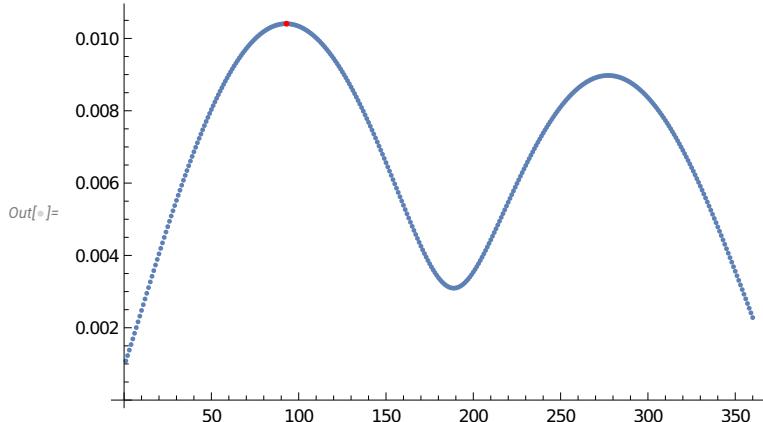
In[]:= f = Abs[Fourier[data]];
peaksize = Last[TakeLargest[f, 12]];
peaks = Flatten[Position[f, x_ /; x > peaksize]]
Out[= {1, 2, 23, 42, 52, 68, 93, 269, 294, 310, 320, 339, 360}

In[= pos2 = 23;
pos2
Out[= 23

In[= Show[ListPlot[f], Graphics[{Red, Point[{pos2, f[[pos2]]}]}]]
Out[= 
n = 360;
fr2 = Abs[Fourier[
  data * Exp[2 Pi I (pos2 - 2) N[Range[0, n - 1]] / n], FourierParameters -> {0, 2/n}];
frpos2 = Position[fr2, Max[fr2][[1, 1]]
Out[= 93

```

```
In[8]:= Show[ListPlot[fr2], Graphics[{Red, Point[{frpos2, fr2[[frpos2]]}]}], PlotRange -> All]
```



```
In[9]:= N[n / (pos2 - 2 + 2 (frpos2 - 1) / n)](*period*)
```

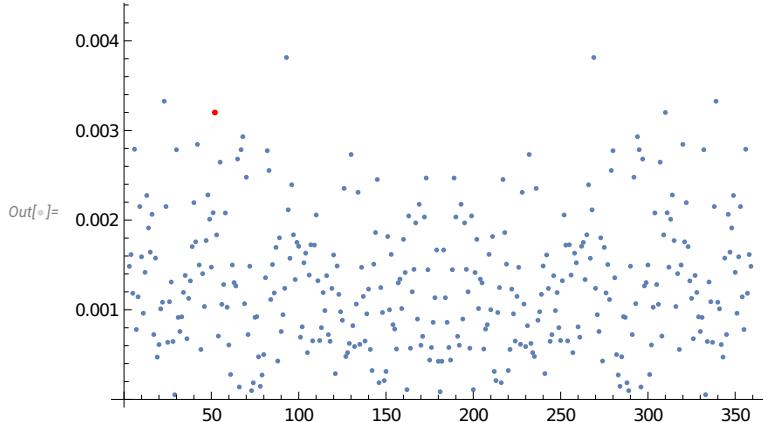
```
Out[9]= 16.7355
```

```
In[10]:= pos3 = 52;
```

```
In[11]:= pos3
```

```
Out[11]= 52
```

```
In[12]:= Show[ListPlot[f], Graphics[{Red, Point[{pos3, f[[pos3]]}]}]]
```

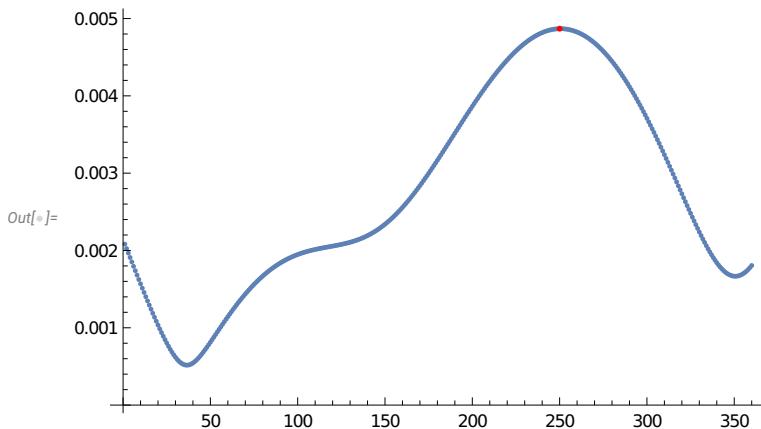


```
In[13]:= n = 360;
```

```
In[14]:= fr3 = Abs[Fourier[
  data * Exp[2 Pi I (pos3 - 2) N[Range[0, n - 1]] / n], FourierParameters -> {0, 2/n}];
frpos3 = Position[fr3, Max[fr3]][[1, 1]]
```

```
Out[14]= 250
```

```
In[8]:= Show[ListPlot[fr3], Graphics[{Red, Point[{frpos3, fr3[[frpos3]]}]}], PlotRange -> All]
```



```
In[9]:= N[n / (pos3 - 2 + 2 (frpos3 - 1) / n)](*period*)
```

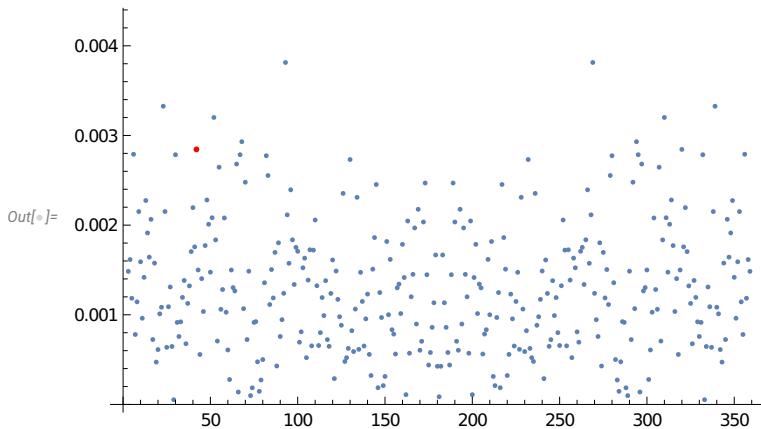
```
Out[9]= 7.00616
```

```
In[10]:= pos4 = 42;
```

```
In[11]:= pos4
```

```
Out[11]= 42
```

```
In[12]:= Show[ListPlot[f], Graphics[{Red, Point[{pos4, f[[pos4]]}]}]]
```



```
In[13]:= n = 360;
```

```
In[14]:= fr4 = Abs[Fourier[
  data * Exp[2 Pi I (pos4 - 2) N[Range[0, n - 1]] / n], FourierParameters -> {0, 2/n}]];
frpos4 = Position[fr4, Max[fr4]][[1, 1]]
```

```
Out[14]= 97
```

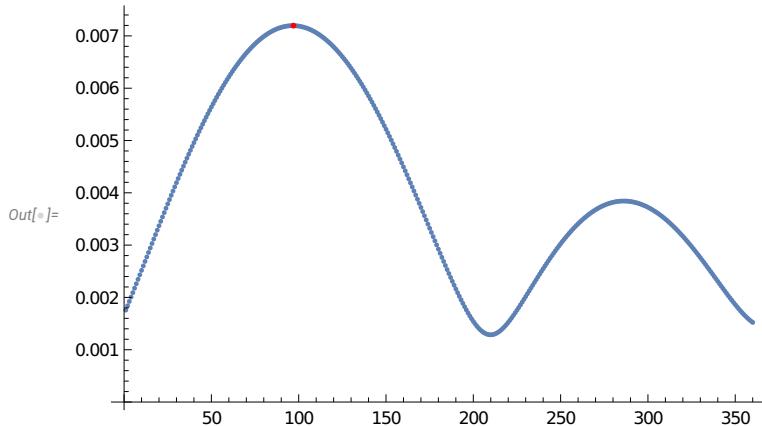
```
In[15]:= fr4
```

```
Out[15]= {0.00175777, 0.00184026, 0.0019234, 0.0020071, 0.00209127, 0.00217585, 0.00226074,
0.0023459, 0.00243126, 0.00251677, 0.00260238, 0.00268803, 0.00277368, 0.0028593,
```

0.00294483, 0.00303025, 0.0031155, 0.00320056, 0.00328538, 0.00336994,
0.00345421, 0.00353814, 0.00362171, 0.00370488, 0.00378763, 0.00386993,
0.00395175, 0.00403305, 0.00411382, 0.00419402, 0.00427363, 0.00435261,
0.00443095, 0.00450862, 0.00458559, 0.00466184, 0.00473734, 0.00481208,
0.00488601, 0.00495913, 0.00503141, 0.00510282, 0.00517335, 0.00524297,
0.00531166, 0.0053794, 0.00544617, 0.00551194, 0.0055767, 0.00564043, 0.00570311,
0.00576471, 0.00582523, 0.00588463, 0.00594291, 0.00600005, 0.00605603,
0.00611083, 0.00616443, 0.00621683, 0.006268, 0.00631792, 0.00636659, 0.006414,
0.00646011, 0.00650493, 0.00654844, 0.00659062, 0.00663147, 0.00667097,
0.0067091, 0.00674587, 0.00678126, 0.00681525, 0.00684784, 0.00687902,
0.00690878, 0.00693711, 0.006964, 0.00698945, 0.00701344, 0.00703598, 0.00705705,
0.00707665, 0.00709478, 0.00711142, 0.00712658, 0.00714024, 0.00715242,
0.00716309, 0.00717227, 0.00717994, 0.00718612, 0.00719078, 0.00719395,
0.0071956, 0.00719575, 0.00719439, 0.00719153, 0.00718717, 0.0071813, 0.00717394,
0.00716508, 0.00715472, 0.00714288, 0.00712955, 0.00711474, 0.00709846,
0.00708071, 0.00706149, 0.00704081, 0.00701869, 0.00699512, 0.00697012,
0.00694369, 0.00691584, 0.00688658, 0.00685592, 0.00682387, 0.00679045,
0.00675565, 0.0067195, 0.006682, 0.00664317, 0.00660302, 0.00656157, 0.00651881,
0.00647478, 0.00642949, 0.00638294, 0.00633516, 0.00628616, 0.00623595,
0.00618456, 0.00613199, 0.00607828, 0.00602343, 0.00596746, 0.00591039,
0.00585225, 0.00579304, 0.0057328, 0.00567154, 0.00560927, 0.00554604, 0.00548184,
0.00541671, 0.00535067, 0.00528375, 0.00521596, 0.00514733, 0.00507788,
0.00500765, 0.00493665, 0.00486491, 0.00479246, 0.00471932, 0.00464553,
0.00457111, 0.00449609, 0.00442051, 0.00434438, 0.00426775, 0.00419065,
0.0041131, 0.00403515, 0.00395683, 0.00387817, 0.00379922, 0.00372, 0.00364057,
0.00356097, 0.00348123, 0.00340141, 0.00332155, 0.0032417, 0.00316191, 0.00308225,
0.00300276, 0.00292351, 0.00284457, 0.00276601, 0.0026879, 0.00261032, 0.00253336,
0.00245711, 0.00238167, 0.00230716, 0.0022337, 0.00216141, 0.00209043, 0.00202093,
0.00195307, 0.00188704, 0.00182303, 0.00176128, 0.00170201, 0.00164549,
0.00159198, 0.00154179, 0.00149521, 0.00145256, 0.00141414, 0.00138026,
0.0013512, 0.00132721, 0.00130851, 0.00129524, 0.00128748, 0.00128525, 0.00128848,
0.00129702, 0.00131067, 0.00132917, 0.0013522, 0.00137943, 0.00141049,
0.00144502, 0.00148267, 0.00152309, 0.00156595, 0.00161093, 0.00165774,
0.00170613, 0.00175584, 0.00180666, 0.00185838, 0.00191082, 0.00196382,
0.00201721, 0.00207087, 0.00212468, 0.00217851, 0.00223228, 0.00228587,
0.00233922, 0.00239224, 0.00244486, 0.00249701, 0.00254864, 0.00259969,
0.00265011, 0.00269985, 0.00274886, 0.00279711, 0.00284455, 0.00289116,
0.00293689, 0.00298172, 0.00302562, 0.00306856, 0.00311051, 0.00315145,
0.00319137, 0.00323022, 0.00326801, 0.0033047, 0.00334028, 0.00337474, 0.00340805,
0.00344021, 0.0034712, 0.003501, 0.00352962, 0.00355702, 0.00358322, 0.00360818,
0.00363192, 0.00365441, 0.00367566, 0.00369565, 0.00371439, 0.00373185,
0.00374805, 0.00376297, 0.00377662, 0.00378898, 0.00380007, 0.00380987,
0.00381839, 0.00382563, 0.00383158, 0.00383625, 0.00383964, 0.00384175,

```
0.00384258, 0.00384215, 0.00384044, 0.00383747, 0.00383324, 0.00382775,
0.00382102, 0.00381305, 0.00380384, 0.00379341, 0.00378175, 0.00376889,
0.00375483, 0.00373958, 0.00372315, 0.00370556, 0.0036868, 0.00366691, 0.00364588,
0.00362373, 0.00360049, 0.00357615, 0.00355074, 0.00352428, 0.00349677,
0.00346824, 0.00343871, 0.0034082, 0.00337672, 0.00334429, 0.00331094, 0.00327669,
0.00324156, 0.00320557, 0.00316876, 0.00313114, 0.00309274, 0.00305359,
0.00301373, 0.00297317, 0.00293195, 0.00289011, 0.00284768, 0.00280469,
0.00276119, 0.0027172, 0.00267278, 0.00262797, 0.00258281, 0.00253735,
0.00249164, 0.00244574, 0.00239969, 0.00235357, 0.00230743, 0.00226134,
0.00221538, 0.00216961, 0.00212412, 0.002079, 0.00203432, 0.0019902, 0.00194674,
0.00190404, 0.00186221, 0.00182139, 0.00178169, 0.00174327, 0.00170625,
0.00167079, 0.00163705, 0.00160517, 0.00157533, 0.00154768, 0.00152239}
```

```
In[1]:= Show[ListPlot[fr4], Graphics[{Red, Point[{frpos4, fr4[[frpos4]]}]}], PlotRange -> All]
```



```
In[2]:= N[n / (pos4 - 2 + 2 (frpos4 - 1) / n)](*period*)
```

```
Out[2]= 8.88158
```

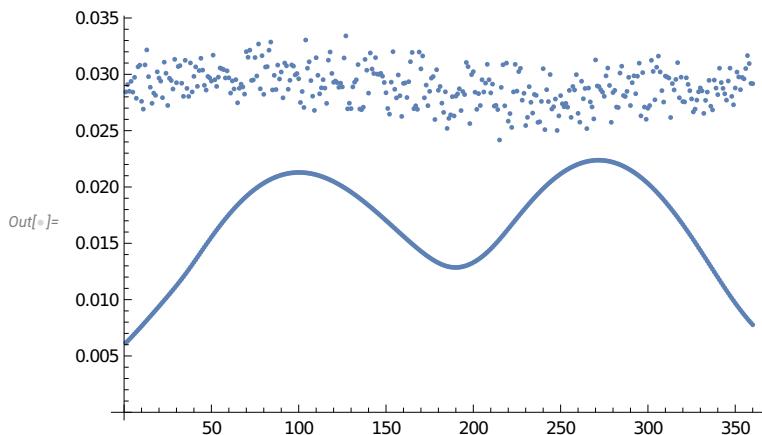
```
In[3]:= {pos1, pos2, pos3, pos4}
```

```
Out[3]= {93, 23, 52, 42}
```

```
In[4]:= {pos1, pos2, pos3, pos4}
```

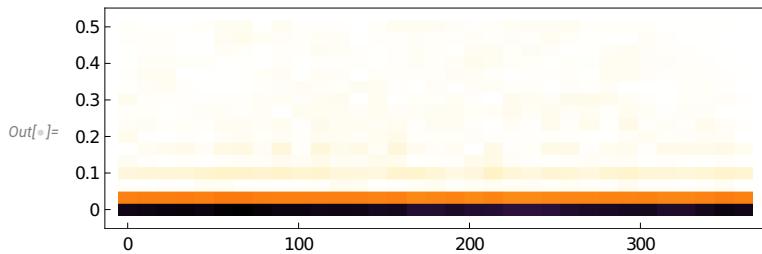
```
Out[4]= {93, 23, 52, 42}
```

```
In[8]:= Show[ListPlot[fr1+fr2+fr3+fr4], ListPlot[data](*,  
Graphics[{Red, Point[{frpos4, fr4[[frpos4]]}]}]*), PlotRange→All]
```

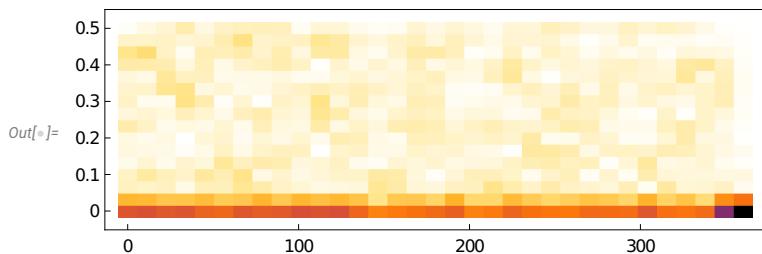


A spectrogram visually confirms this frequency and period. A random data spectrogram follows for comparison.

```
In[9]:= Spectrogram[data]
```

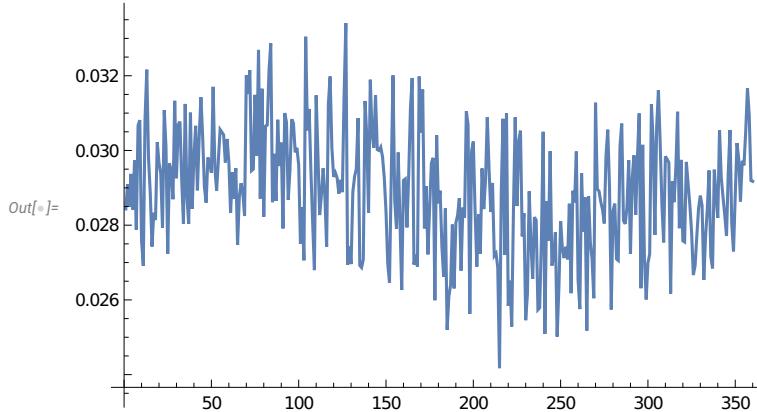


```
In[10]:= Spectrogram[RandomReal[Max[data], 360](*Length[just]*)]
```



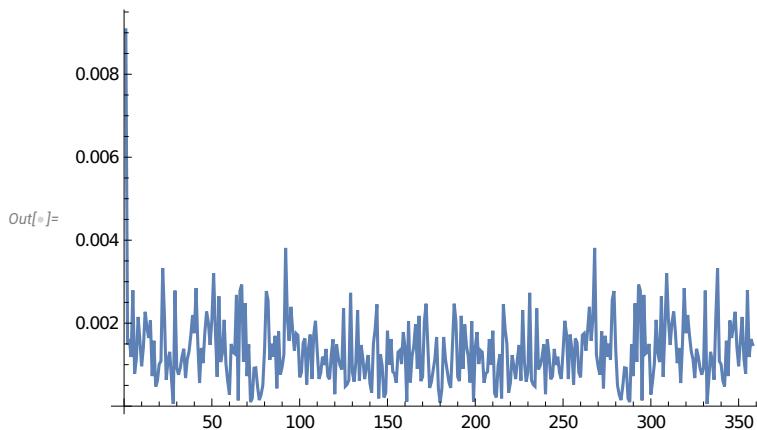
We can see more particularly the spikes directly in the Fourier transform of the data.

```
In[8]:= ListLinePlot[data, PlotRange -> All]
```

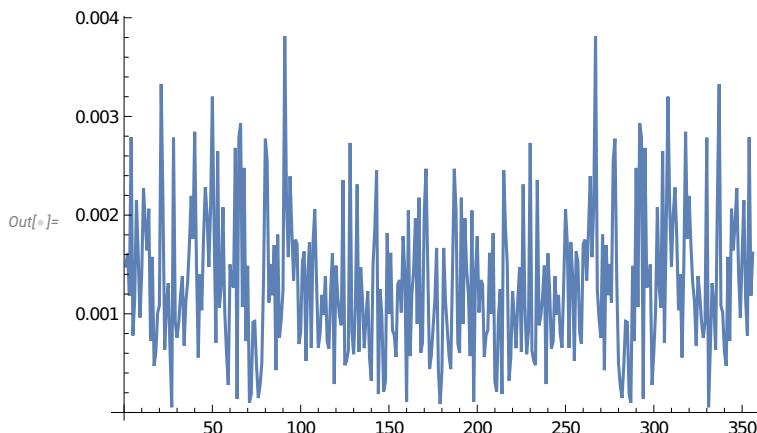


```
In[9]:=
```

```
In[10]:= ListLinePlot[(Abs[Fourier[data]])[[2 ;; -2]], PlotRange -> All]
```



```
In[11]:= ListLinePlot[(Abs[Fourier[data]])[[3 ;; -3]], PlotRange -> All]
```



Going back to the data values, let's fit the results. They look like they fit well to a normal curve.

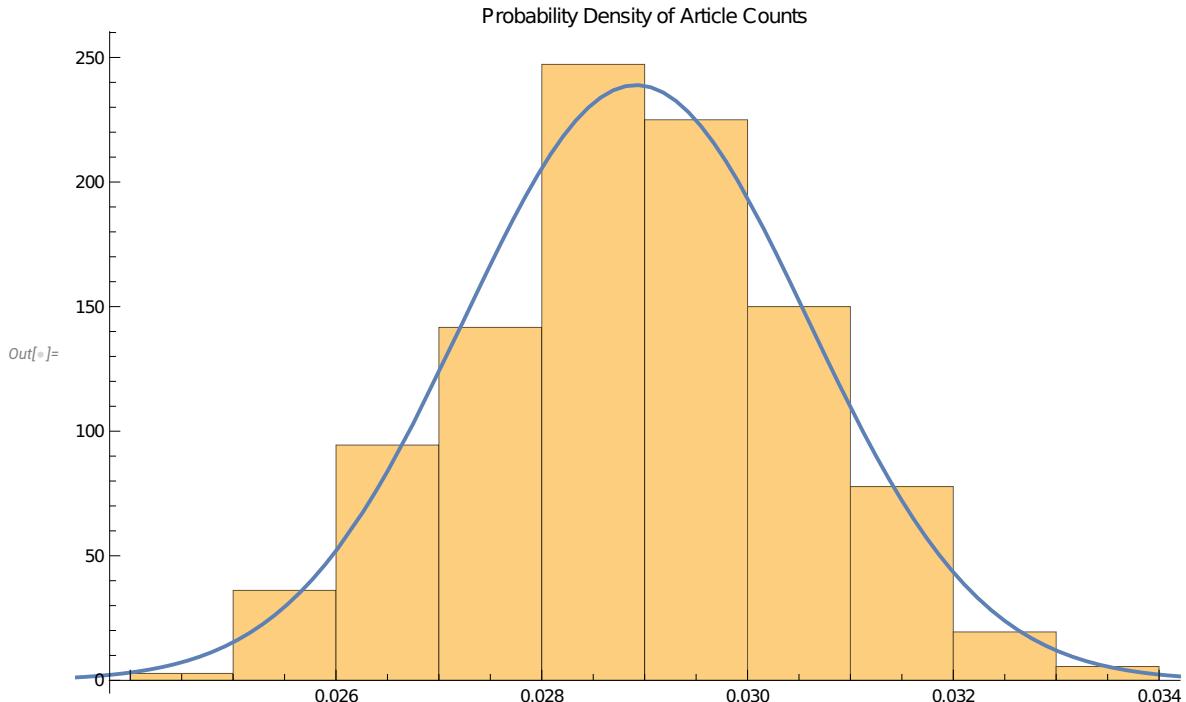
```
In[®]:= FindDistribution[data, 3]
Out[®]= {NormalDistribution[0.0289161, 0.00166978],
          NormalDistribution[0.0289161, 0.00166978], GammaDistribution[300.821, 0.0000962566]}

In[®]:= dist = FindDistribution[data]
Out[®]= NormalDistribution[0.0289161, 0.00166978]

In[®]:= H = DistributionFitTest[data, dist, "HypothesisTestData"]; H[["TestDataTable", All]
Out[®]=
```

	Statistic	P-Value
Anderson-Darling	0.231796	0.979165
Baringhaus-Henze	0.129938	0.992943
Cramér-von Mises	0.0339171	0.961598
Jarque-Bera ALM	1.47197	0.455777
Kolmogorov-Smirnov	0.0275604	0.940283
Kuiper	0.0477874	0.849926
Mardia Combined	1.47197	0.455777
Mardia Kurtosis	-1.15808	0.246829
Mardia Skewness	0.221264	0.638078
Pearson χ^2	14.	0.869599
Shapiro-Wilk	0.997237	0.80798
Watson U ²	0.0325524	0.906155

```
In[1]:= Show[Histogram[data, Automatic, "ProbabilityDensity"],
  Plot[PDF[dist, x], {x, 0, 0.4}, PlotStyle -> Thick, PlotRange -> All],
  PlotLabel -> "Probability Density of Article Counts", ImageSize -> Large]
```



```
In[2]:= FindDistribution[data]
```

```
Out[2]= NormalDistribution[0.0289161, 0.00166978]
```

```
In[3]:= d = DistributionFitTest[data, %, "TestDataTable"]
```

	Statistic	P-Value
Cramér-von Mises	0.0339171	0.961598

```
In[4]:= Max[data]
```

```
Out[4]= 0.0334092
```

```
In[5]:= d = DistributionFitTest[data, UniformDistribution[{0, Max[data]}]]
```

```
Out[5]= 1.11022 × 10-15
```

```
In[6]:= DistributionFitTest[data, UniformDistribution[{0, Max[data]}], "TestDataTable"]
```

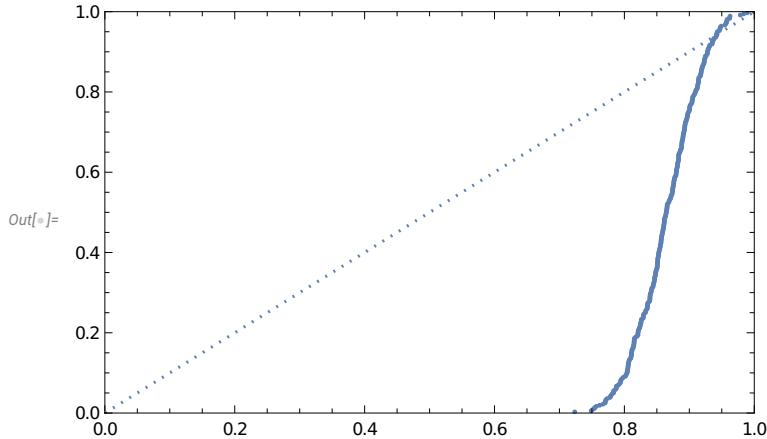
	Statistic	P-Value
Cramér-von Mises	68.9468	1.11022 × 10 ⁻¹⁵

```
In[7]:= $MinNumber
```

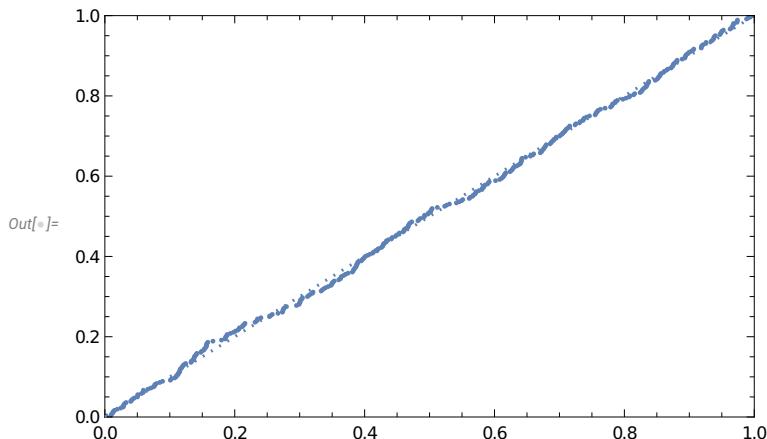
```
Out[7]= 6.229688249675322 × 10-1355 718 576 299 610
```

The match to the normal curve is seen in a probability plot.

```
In[8]:= ProbabilityPlot[data, UniformDistribution[{0, Max[data]}]]
```



```
In[9]:= ProbabilityPlot[data, dist]
```



Let's look closer at the sampling errors of the average normalized article counts.
At most they are less than 1 percent of their corresponding values.

```
In[10]:= errors = samplingerrors;
```

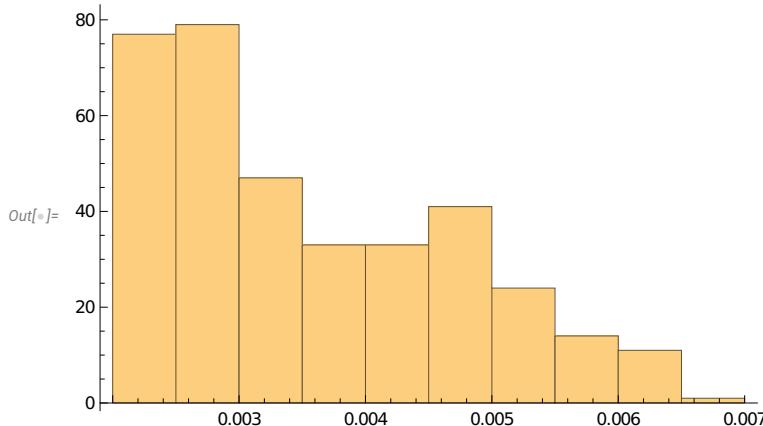
```
In[11]:= Mean[errors / data]
```

```
Out[11]= 0.00355825
```

```
In[12]:= Max[errors / data]
```

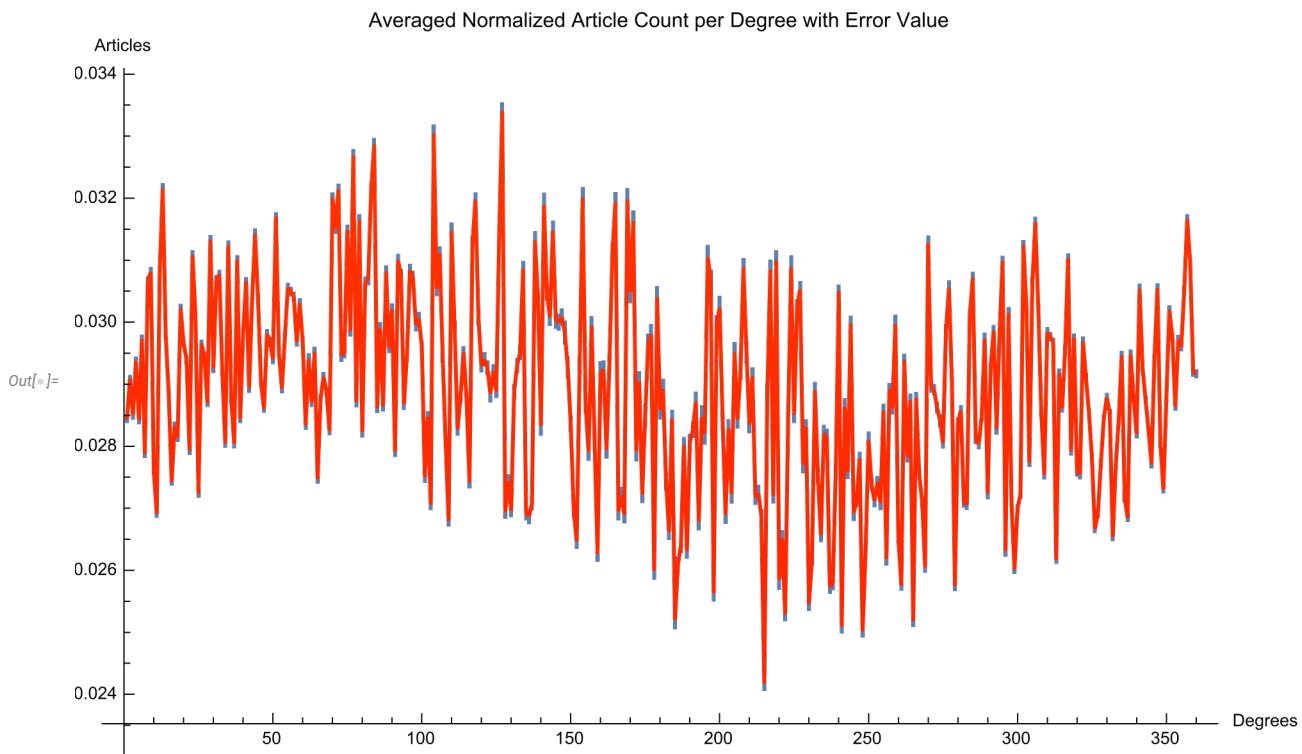
```
Out[12]= 0.00660398
```

```
In[8]:= Histogram[errors / data]
```



A plot of the values with error bars

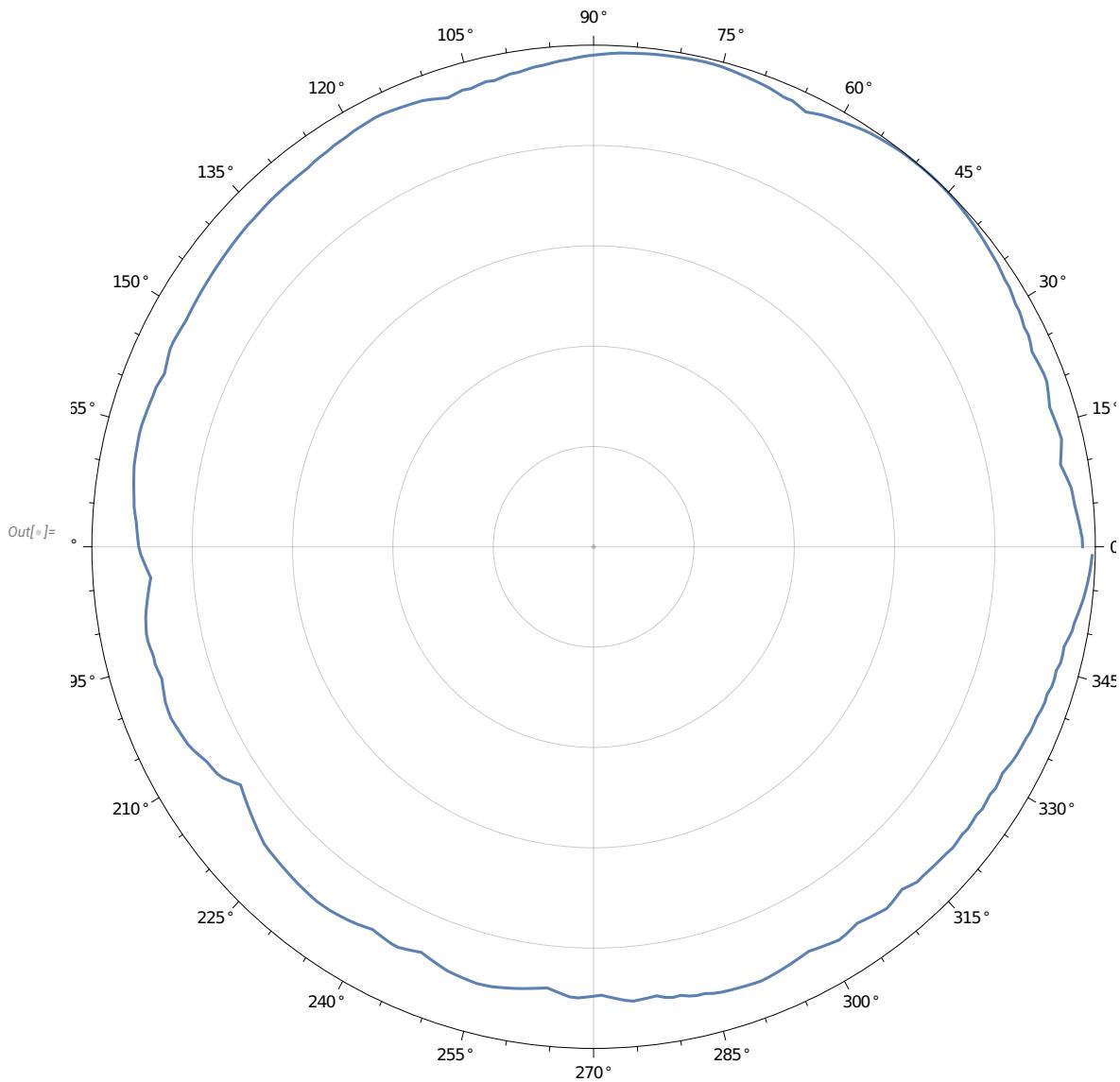
```
In[9]:= ListLinePlot[Table[Around[data[[i + 1]], errors[[i + 1]]], {i, 0, 359}],
 PlotRange → All, ColorFunction → Function[{x, y}, Hue[y]],
 PlotStyle → Thick, ColorFunctionScaling → False,
 PlotLabel → "Averaged Normalized Article Count per Degree with Error Value",
 AxesLabel → {"Degrees", "Articles"}]
```



Let's look at the peaks and the base of the peaks.

```
In[=]:= peaksB = FindPeaks[data, sd];
In[=]:= base = EstimatedBackground[data];
In[=]:= ListPolarPlot[base,
  PlotLabel -> "Estimated background of data suggestive of twelve?",
  PolarAxes -> Automatic, PolarGridLines -> {{0, Pi/2, Pi, 3 Pi/2}, Automatic},
  PolarTicks -> {"Degrees", Automatic}(*, PlotLegends -> {"True", "False", "Markers"})*),
  PlotRange -> All, ImageSize -> Large, Joined -> True]
```

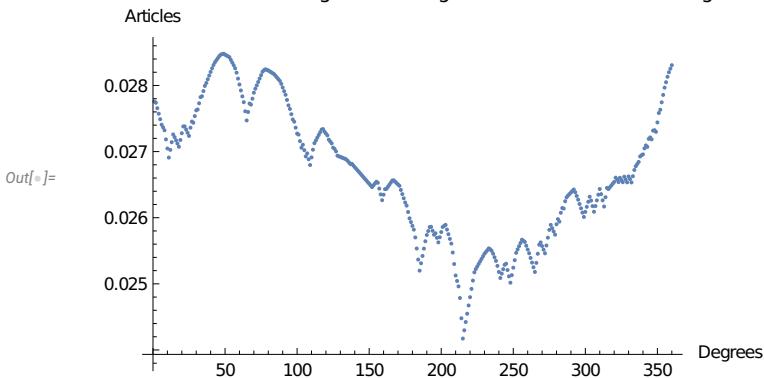
Estimated background of data suggestive of twelve?



The base as a moving average with a window of 7 degrees may show 12 peaks, consistent with the Fourier transform peak above at 30 and perhaps substantiating the idea of (unequal) houses.

```
In[8]:= ListPlot[base, PlotLabel →
  "Automated Estimated Background of Degree Counts over the 360 Degrees",
  AxesLabel → {"Degrees", "Articles"}]
```

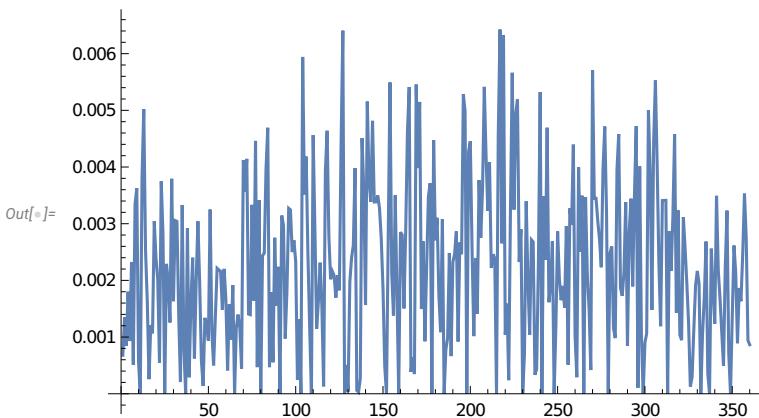
Automated Estimated Background of Degree Counts over the 360 Degrees



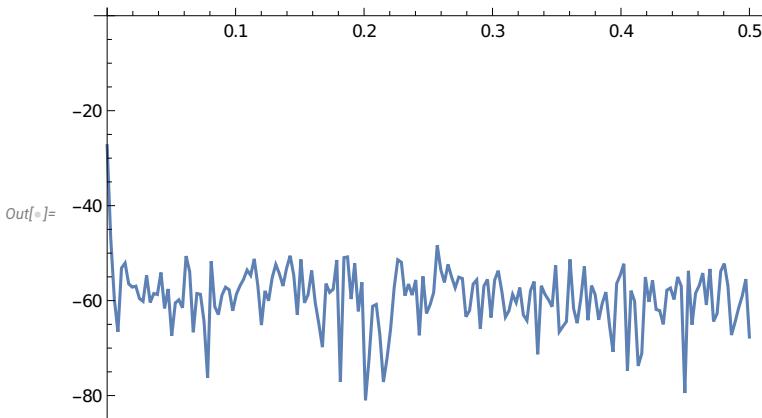
FindPeaks[base]

```
Out[8]= {{1, 0.0277563}, {14, 0.0272593}, {22, 0.0273804}, {49, 0.0284794}, {78, 0.0282446},
{118, 0.0273402}, {155, 0.0265441}, {167, 0.0265658}, {193, 0.0258622}, {203, 0.025892},
{233, 0.0255366}, {245, 0.0253046}, {256, 0.0256671}, {269, 0.0256265},
{276, 0.0258917}, {292, 0.0264265}, {303, 0.026317}, {310, 0.0264338},
{321, 0.0266055}, {324, 0.0266036}, {327, 0.0266202}, {330, 0.026624}, {360, 0.0283071}}
```

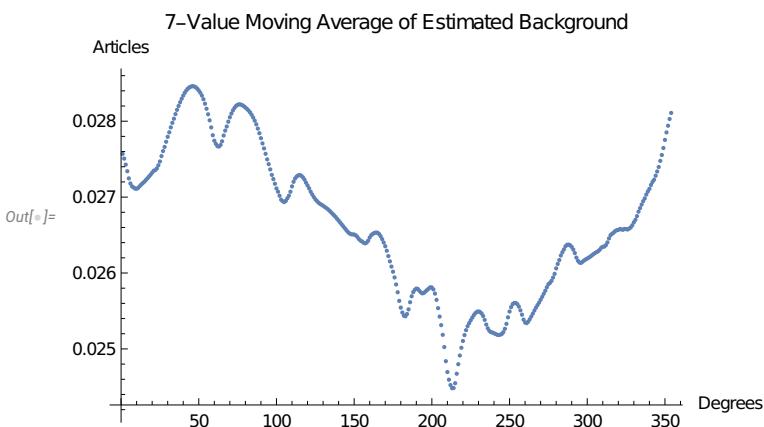
```
In[9]:= ListLinePlot[data - base]
```



In[1]:= **Periodogram**[data - base]



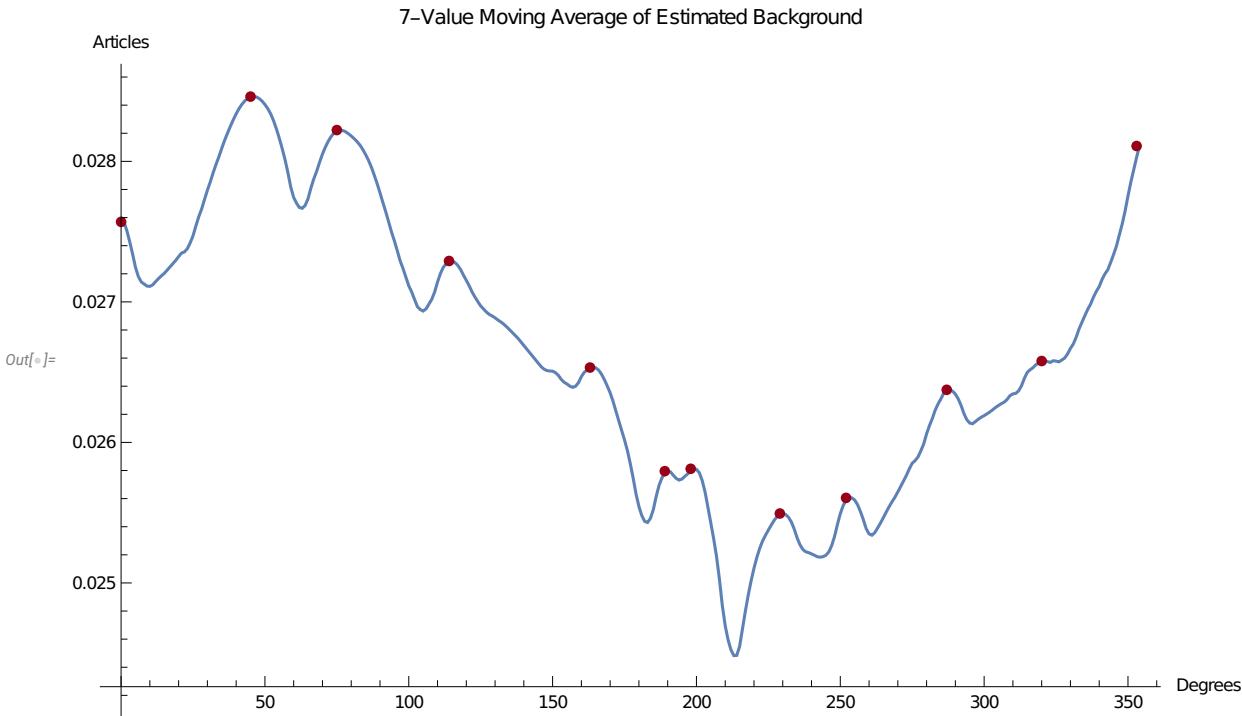
In[2]:= **ListPlot**[MovingAverage[base, 7],
PlotLabel → "7-Value Moving Average of Estimated Background",
AxesLabel → {"Degrees", "Articles"}]



In[3]:= **backgroundpeaks = FindPeaks**[MovingAverage[base, 7]]

Out[3]= {{1, 0.0275694}, {46, 0.0284607}, {76, 0.0282227}, {115, 0.027291},
{164, 0.0265328}, {190, 0.0257955}, {199, 0.0258124}, {230, 0.0254942},
{253, 0.0256053}, {288, 0.0263744}, {321, 0.0265792}, {354, 0.0281092}}

```
In[8]:= ListLinePlot[
  {MovingAverage[base, 7],
   Style[Transpose[{backgroundpeaks[[All, 1]] - 1, backgroundpeaks[[All, 2]]}], colors[[3]]]},
  Joined → {True, False},
  PlotStyle → {Automatic, PointSize[.01]},
  PlotLabel → "7-Value Moving Average of Estimated Background",
  AxesLabel → {"Degrees", "Articles"}]
```



```
In[9]:= backgroundpeaks = FindPeaks[MovingAverage[base, 7]]
Out[9]= {{1, 0.0275694}, {46, 0.0284607}, {76, 0.0282227}, {115, 0.027291},
{164, 0.0265328}, {190, 0.0257955}, {199, 0.0258124}, {230, 0.0254942},
{253, 0.0256053}, {288, 0.0263744}, {321, 0.0265792}, {354, 0.0281092}}
```



```
In[10]:= Length[FindPeaks[MovingAverage[base, 7]]]
Out[10]= 12
```

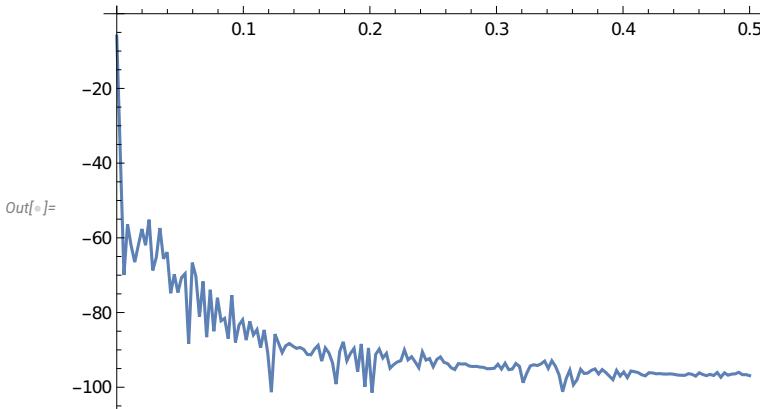


```
In[11]:= 
In[11]:= FindPeaks[MovingAverage[base, 7], StandardDeviation[MovingAverage[base, 7]]]
Out[11]= {{1, 0.0275694}, {46, 0.0284607}, {76, 0.0282227}, {115, 0.027291}, {164, 0.0265328},
{190, 0.0257955}, {199, 0.0258124}, {230, 0.0254942}, {253, 0.0256053},
{288, 0.0263744}, {321, 0.0265792}, {324, 0.0265812}, {354, 0.0281092}}
```



```
In[12]:= Length[%]
Out[12]= 13
```

```
In[1]:= Periodogram[MovingAverage[base, 7], PlotRange -> All]
```



```
In[2]:= peaksB[[All, 1]] - 1
```

```
Out[2]= {3, 8, 12, 18, 22, 28, 31, 34, 37, 40, 43, 50, 54, 71, 76, 83, 87, 91, 95, 103, 109, 113, 117, 126, 133, 137, 140, 143, 153, 164, 168, 170, 176, 178, 191, 195, 199, 207, 216, 226, 231, 234, 239, 243, 249, 254, 258, 261, 265, 269, 276, 280, 284, 288, 291, 294, 301, 305, 309, 316, 321, 329, 334, 340, 346, 350, 356}
```

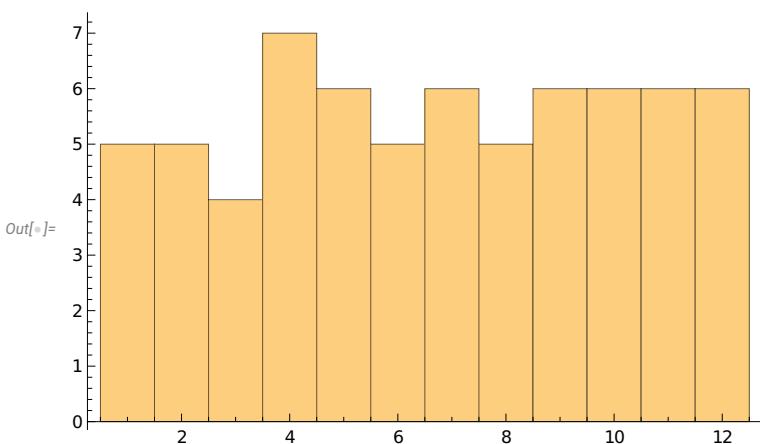
```
In[3]:= peaksB[[All, 1]] - 1
```

```
Out[3]= {3, 8, 12, 18, 22, 28, 31, 34, 37, 40, 43, 50, 54, 71, 76, 83, 87, 91, 95, 103, 109, 113, 117, 126, 133, 137, 140, 143, 153, 164, 168, 170, 176, 178, 191, 195, 199, 207, 216, 226, 231, 234, 239, 243, 249, 254, 258, 261, 265, 269, 276, 280, 284, 288, 291, 294, 301, 305, 309, 316, 321, 329, 334, 340, 346, 350, 356}
```

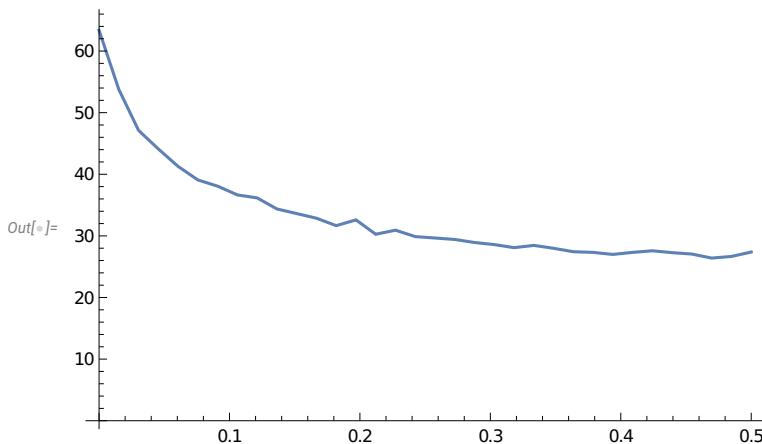
```
In[4]:= h0 = Mod[peaksB[[All, 1]] - 1, 12] + 1
```

```
Out[4]= {4, 9, 1, 7, 11, 5, 8, 11, 2, 5, 8, 3, 7, 12, 5, 12, 4, 8, 12, 8, 2, 6, 10, 7, 2, 6, 9, 12, 10, 9, 1, 3, 9, 11, 12, 4, 8, 4, 1, 11, 4, 7, 12, 4, 10, 3, 7, 10, 2, 6, 1, 5, 9, 1, 4, 7, 2, 6, 10, 5, 10, 6, 11, 5, 11, 3, 9}
```

```
In[5]:= Histogram[h0, 12]
```



In[1]:= **Periodogram[peaksB[[All, 1]] - 1]**



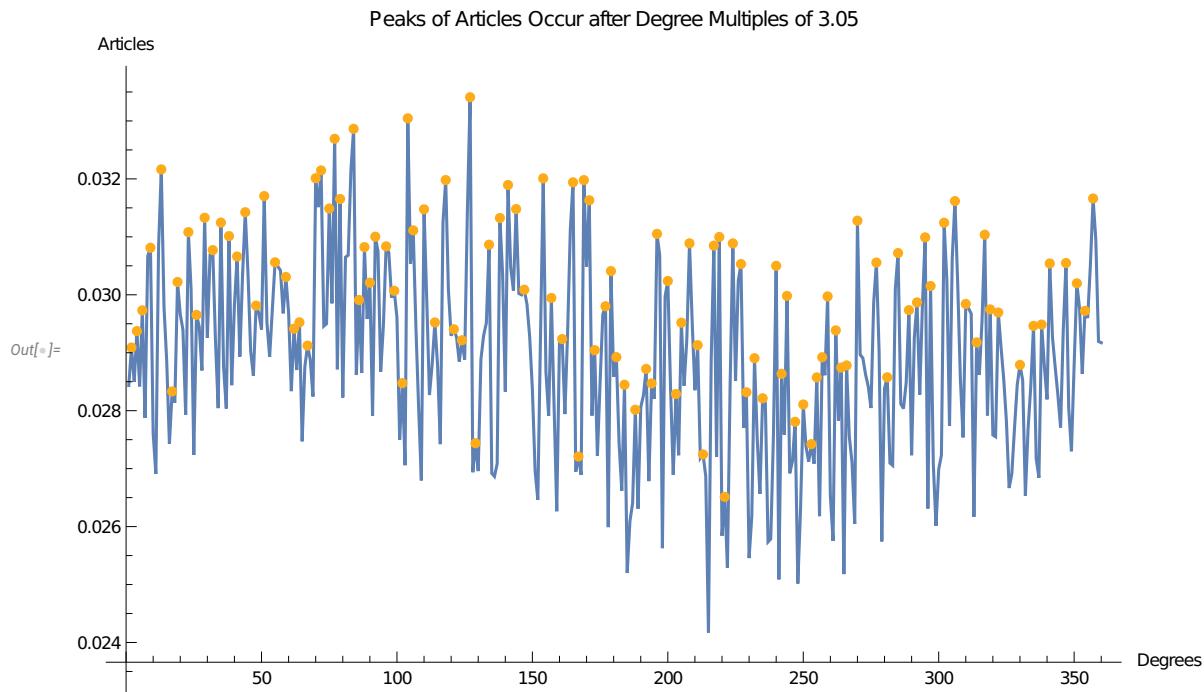
In[2]:= **data**

```
Out[2]= {0.0284361, 0.0290893, 0.0284982, 0.0293737, 0.028419, 0.0297311, 0.0278757,
0.0306673, 0.0308112, 0.0276028, 0.0269094, 0.0308375, 0.0321638, 0.0297927,
0.0288552, 0.027427, 0.0283326, 0.0281379, 0.0302212, 0.029665, 0.0293942,
0.0279263, 0.0310809, 0.0300927, 0.0272368, 0.0296532, 0.0294515, 0.0286947,
0.0313297, 0.0292557, 0.0306916, 0.0307711, 0.0292105, 0.028044, 0.0312456,
0.0287522, 0.0280377, 0.0310129, 0.0284394, 0.0298188, 0.0306607, 0.0289329,
0.0303357, 0.0314249, 0.0303757, 0.0290256, 0.028603, 0.0298134, 0.0296852,
0.0294014, 0.0317037, 0.029522, 0.0289287, 0.0297509, 0.0305606, 0.0304917,
0.0304189, 0.0296792, 0.0303074, 0.0296908, 0.0283368, 0.0294147, 0.0287021,
0.0295248, 0.0274711, 0.0287618, 0.0291229, 0.0288768, 0.028245, 0.0320116,
0.031512, 0.0321461, 0.029459, 0.0294999, 0.031489, 0.0298521, 0.0326921, 0.028714,
0.031653, 0.0282272, 0.0306484, 0.0306817, 0.032144, 0.0328643, 0.0286152,
0.0299095, 0.02865, 0.0308226, 0.0295827, 0.0302089, 0.0279134, 0.0310025,
0.0307556, 0.0286746, 0.0294689, 0.0308359, 0.0307293, 0.0299506, 0.0300688,
0.0296063, 0.0274996, 0.0284756, 0.0270589, 0.0330454, 0.030539, 0.0311115,
0.029443, 0.0280583, 0.0267966, 0.0314749, 0.0299161, 0.0282708, 0.0288016,
0.0295221, 0.0287761, 0.0274223, 0.0312549, 0.0319803, 0.0300784, 0.0292927,
0.0294041, 0.0292671, 0.0288477, 0.0292154, 0.0288835, 0.0314527, 0.0334092,
0.0269377, 0.0274382, 0.0269577, 0.0288843, 0.0292987, 0.0295127, 0.0308645,
0.0269208, 0.0268655, 0.0270826, 0.031325, 0.030364, 0.0283301, 0.0318948,
0.0304712, 0.0300741, 0.0314799, 0.0300229, 0.0299988, 0.0300871, 0.0298355,
0.0292753, 0.0283649, 0.026969, 0.0264639, 0.0293044, 0.0320098, 0.0286707, 0.02791,
0.0299448, 0.0280975, 0.0262646, 0.0291987, 0.0292362, 0.0279413, 0.0293459,
0.0311227, 0.0319408, 0.0269473, 0.0272084, 0.0268916, 0.0319791, 0.0304849,
0.0316307, 0.0279149, 0.0290444, 0.0272187, 0.0284902, 0.0296621, 0.0298022,
0.0259906, 0.0304092, 0.0285847, 0.0289238, 0.0274401, 0.0266201, 0.0284474,
0.0251996, 0.0260894, 0.0264054, 0.0280166, 0.0263082, 0.0280608, 0.0282637,
0.028721, 0.0267842, 0.0284708, 0.0282039, 0.0310513, 0.0306831, 0.0256274,
```

```
0.0299744, 0.0302392, 0.028411, 0.0268921, 0.0282876, 0.0272309, 0.0295187,  
0.0284311, 0.0292189, 0.030888, 0.0295172, 0.0283526, 0.029131, 0.0271801,  
0.0272456, 0.0268709, 0.0241725, 0.0288412, 0.0308484, 0.0272023, 0.0309978,  
0.0258413, 0.0265129, 0.025288, 0.0284406, 0.030887, 0.0285126, 0.030241, 0.0305301,  
0.0277015, 0.0283182, 0.0254561, 0.026178, 0.0289057, 0.0275169, 0.0265631,  
0.0282146, 0.0281343, 0.0257354, 0.0257867, 0.0275971, 0.0305003, 0.0250887,  
0.0286367, 0.0275837, 0.0299809, 0.0269191, 0.0271232, 0.0278081, 0.0250176,  
0.0263104, 0.0281071, 0.0273854, 0.0271193, 0.0274228, 0.0270848, 0.028575,  
0.0261792, 0.0289222, 0.0286117, 0.0299716, 0.0265347, 0.0257538, 0.0293858,  
0.0278307, 0.0287447, 0.02518, 0.0287814, 0.0275533, 0.0271049, 0.0260446,  
0.0312786, 0.0289664, 0.0289098, 0.0286249, 0.0284162, 0.028047, 0.0298645,  
0.0305565, 0.0290134, 0.0257437, 0.0283821, 0.0285765, 0.0270962, 0.0270562,  
0.030112, 0.0307197, 0.0281179, 0.0280355, 0.0284853, 0.0297356, 0.0272311,  
0.0292573, 0.0298684, 0.0282791, 0.0298311, 0.030991, 0.0263123, 0.0301516,  
0.0270942, 0.0260118, 0.0269904, 0.0272282, 0.0312433, 0.0302584, 0.0277386,  
0.0306288, 0.0316165, 0.030213, 0.0285528, 0.0275391, 0.0298418, 0.0297673,  
0.0296744, 0.0261693, 0.0291788, 0.0286164, 0.0295502, 0.0310366, 0.0279183,  
0.0297483, 0.0275803, 0.0275507, 0.0296945, 0.0291077, 0.0285463, 0.0278181,  
0.0266653, 0.0269128, 0.0277101, 0.0284481, 0.0287905, 0.0285282, 0.0265334,  
0.0276891, 0.0284252, 0.0294637, 0.0271685, 0.0268438, 0.0294862, 0.0287769,  
0.0281955, 0.0305408, 0.0292695, 0.0287522, 0.0282718, 0.0277104, 0.0294102,  
0.0305477, 0.0280443, 0.0272991, 0.0287844, 0.0301981, 0.0297668, 0.028636,  
0.0297227, 0.0295994, 0.0305125, 0.0316617, 0.0309546, 0.0291947, 0.0291727}
```

```
In[8]:= colors = {Yellow, Purple, Maroon, Green, Magenta, Orange, Cyan, Red, Blue, Black, Gold};
```

```
In[®]:= ListLinePlot[
  {data, Style[Transpose[{peaksB[[All, 1]], peaksB[[All, 2]]}], colors[-1]}],
  Joined → {True, False},
  PlotStyle → {Automatic, PointSize[.01]},
  PlotLabel → "Peaks of Articles Occur after Degree Multiples of 3.05",
  AxesLabel → {"Degrees", "Articles"}]
```



```
In[®]:= lmB = LinearModelFit[peaksB[[All, 1]] - 1, x, x]
```

```
Out[®]= FittedModel[ $-3.66837 + 3.05648x$ ]
```

```
In[®]:= lmB["BestFit"](*this implies that peaks occur about every three degrees,
i.e. in the tenth harmonic or D10 and/or may suggest orb*)
```

```
Out[®]=  $-3.66837 + 3.05648x$ 
```

```
In[®]:= 30^(1/2)
```

```
Out[®]=  $\sqrt{30}$ 
```

```
In[®]:= N[ $\sqrt{30}$ ]
```

```
Out[®]= 5.47723
```

In[1]:= lmB["ANOVATable"]

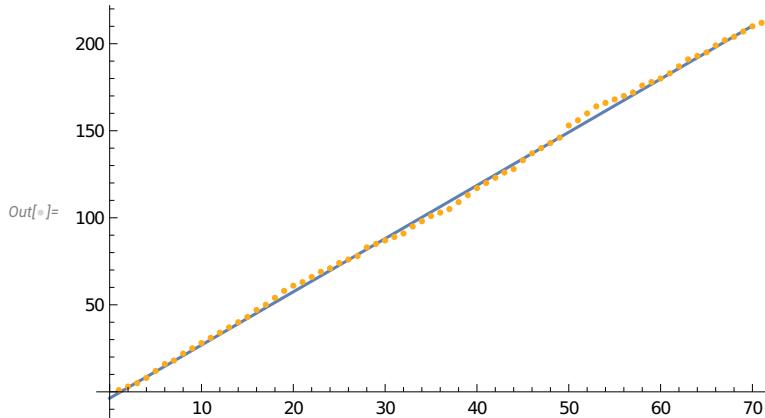
	DF	SS	MS	F-Statistic	P-Value
x	1	1.1533×10^6	1.1533×10^6	79340.2	1.68631×10^{-161}
Error	112	1628.04	14.5361		
Total	113	1.15493×10^6			

In[2]:= lmB["ANOVATable"] // OutputForm

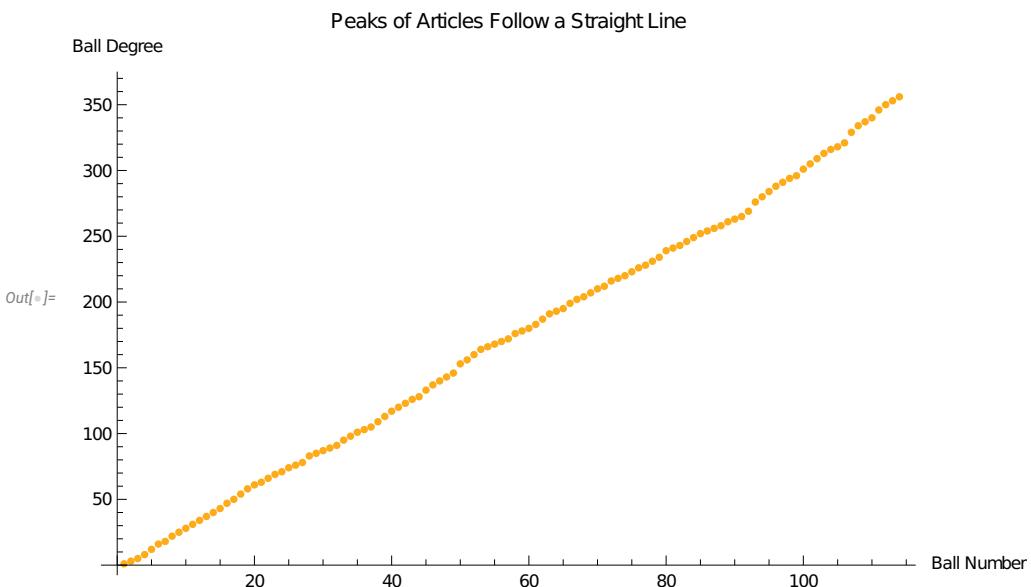
Out[2]//OutputForm=

	DF	SS	MS	F-Statistic	P-Value
x	1	1.1533×10^6	1.1533×10^6	79340.2	1.68631×10^{-161}
Error	112	1628.04	14.5361		
Total	113	1.15493×10^6			

In[3]:= Show[Plot[lmB["BestFit"], {x, 0, 70}], ListPlot[Style[peaksB[[All, 1]] - 1, colors[-1]]]]

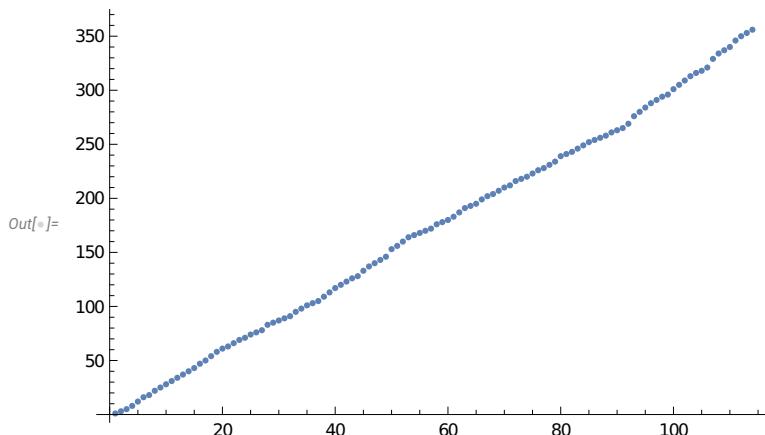


```
In[®]:= ListPlot[Style[peaksB[[All, 1]] - 1, colors[-1]],  
 PlotLabel → "Peaks of Articles Follow a Straight Line",  
 AxesLabel → {"Ball Number", "Ball Degree"}]
```

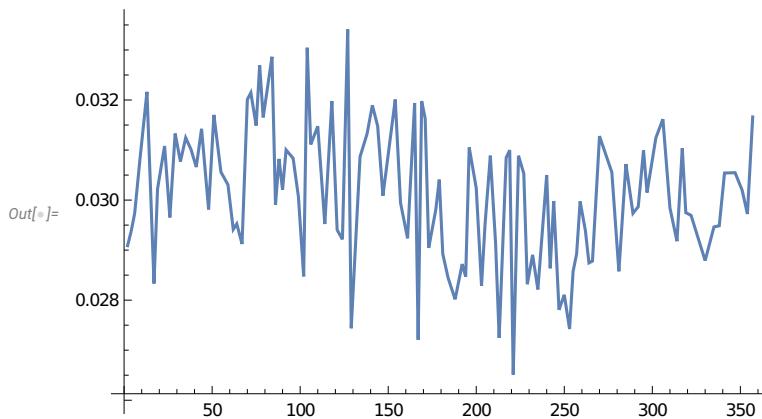


```
In[]:= peaksB
Out[]:= {{2, 0.0290893}, {4, 0.0293737}, {6, 0.0297311}, {9, 0.0308112}, {13, 0.0321638},
{17, 0.0283326}, {19, 0.0302212}, {23, 0.0310809}, {26, 0.0296532}, {29, 0.0313297},
{32, 0.0307711}, {35, 0.0312456}, {38, 0.0310129}, {41, 0.0306607}, {44, 0.0314249},
{48, 0.0298134}, {51, 0.0317037}, {55, 0.0305606}, {59, 0.0303074}, {62, 0.0294147},
{64, 0.0295248}, {67, 0.0291229}, {70, 0.0320116}, {72, 0.0321461}, {75, 0.031489},
{77, 0.0326921}, {79, 0.031653}, {84, 0.0328643}, {86, 0.0299095}, {88, 0.0308226},
{90, 0.0302089}, {92, 0.0310025}, {96, 0.0308359}, {99, 0.0300688}, {102, 0.0284756},
{104, 0.0330454}, {106, 0.0311115}, {110, 0.0314749}, {114, 0.0295221}, {118, 0.0319803},
{121, 0.0294041}, {124, 0.0292154}, {127, 0.0334092}, {129, 0.0274382}, {134, 0.0308645},
{138, 0.031325}, {141, 0.0318948}, {144, 0.0314799}, {147, 0.0300871}, {154, 0.0320098},
{157, 0.0299448}, {161, 0.0292362}, {165, 0.0319408}, {167, 0.0272084}, {169, 0.0319791},
{171, 0.0316307}, {173, 0.0290444}, {177, 0.0298022}, {179, 0.0304092},
{181, 0.0289238}, {184, 0.0284474}, {188, 0.0280166}, {192, 0.028721}, {194, 0.0284708},
{196, 0.0310513}, {200, 0.0302392}, {203, 0.0282876}, {205, 0.0295187}, {208, 0.030888},
{211, 0.029131}, {213, 0.0272456}, {217, 0.0308484}, {219, 0.0309978}, {221, 0.0265129},
{224, 0.030887}, {227, 0.0305301}, {229, 0.0283182}, {232, 0.0289057}, {235, 0.0282146},
{240, 0.0305003}, {242, 0.0286367}, {244, 0.0299809}, {247, 0.0278081}, {250, 0.0281071},
{253, 0.0274228}, {255, 0.028575}, {257, 0.0289222}, {259, 0.0299716}, {262, 0.0293858},
{264, 0.0287447}, {266, 0.0287814}, {270, 0.0312786}, {277, 0.0305565}, {281, 0.0285765},
{285, 0.0307197}, {289, 0.0297356}, {292, 0.0298684}, {295, 0.030991}, {297, 0.0301516},
{302, 0.0312433}, {306, 0.0316165}, {310, 0.0298418}, {314, 0.0291788}, {317, 0.0310366},
{319, 0.0297483}, {322, 0.0296945}, {330, 0.0287905}, {335, 0.0294637}, {338, 0.0294862},
{341, 0.0305408}, {347, 0.0305477}, {351, 0.0301981}, {354, 0.0297227}, {357, 0.0316617}}
```

```
In[]:= ListPlot[peaksB[[All, 1]] - 1]
```



```
In[1]:= ListPlot[peaksB, Joined → True]
```



```
In[2]:= fp2 = FindPeaks[peaksB[[All, 2]], StandardDeviation[peaksB[[All, 2]]]]
(*These are peaks of the peaks*)
```

```
Out[2]= {{5, 0.0321638}, {8, 0.0310809}, {10, 0.0313297}, {12, 0.0312456}, {15, 0.0314249},
{17, 0.0317037}, {21, 0.0295248}, {24, 0.0321461}, {26, 0.0326921},
{28, 0.0328643}, {30, 0.0308226}, {32, 0.0310025}, {36, 0.0330454}, {38, 0.0314749},
{40, 0.0319803}, {43, 0.0334092}, {47, 0.0318948}, {50, 0.0320098}, {53, 0.0319408},
{55, 0.0319791}, {59, 0.0304092}, {63, 0.028721}, {65, 0.0310513}, {69, 0.030888},
{73, 0.0309978}, {75, 0.030887}, {78, 0.0289057}, {80, 0.0305003}, {82, 0.0299809},
{84, 0.0281071}, {88, 0.0299716}, {92, 0.0312786}, {95, 0.0307197}, {98, 0.030991},
{101, 0.0316165}, {104, 0.0310366}, {111, 0.0305477}, {114, 0.0316617}}
```

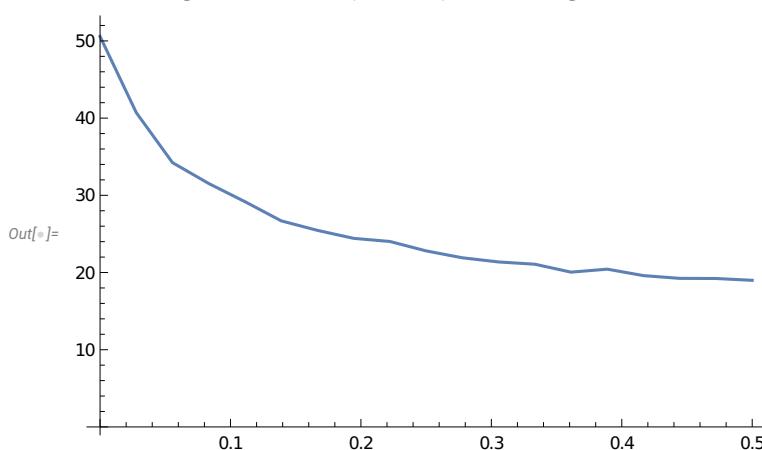
```
In[3]:= (*fp2=FindPeaks[peaksB[[All,2]]] (*These are peaks of the peaks*)*)
```

```
In[4]:= Length[fp2]
```

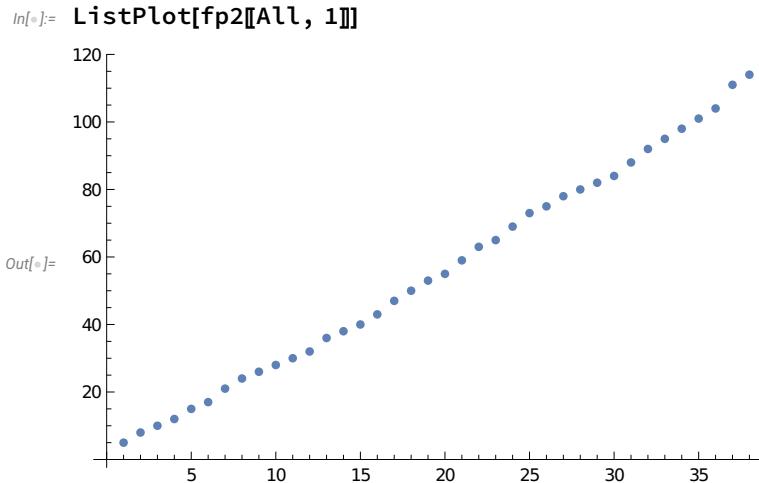
```
Out[4]= 38
```

```
In[5]:= (*fp2=FindPeaks[peaksB[[All,2]](*,StandardDeviation[peaksB[[All,2]]]*)*)
(*These are peaks of the peaks*)*)
```

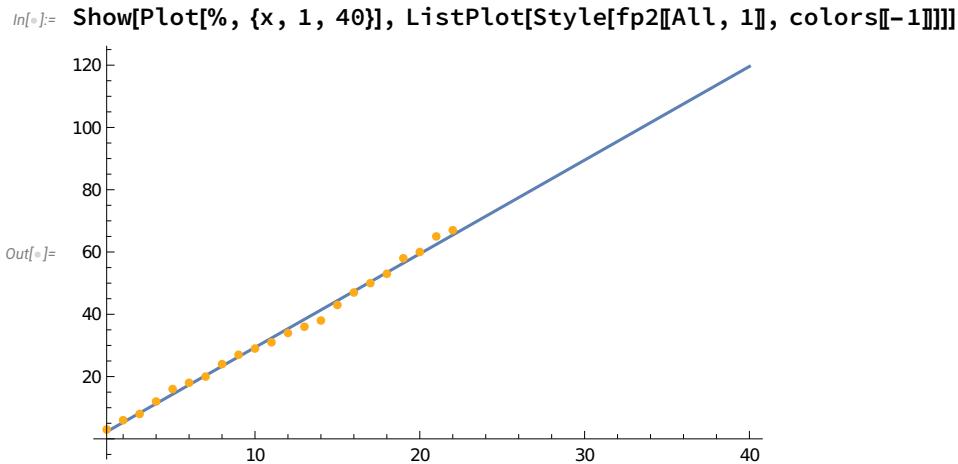
```
In[6]:= Periodogram[fp2[[All, 1]] - 1, PlotRange → All]
```



```
In[1]:= f = Abs[Fourier[fp2[[All, 1]]];
peaksize = Last[TakeLargest[f, 7]];
peaks = Flatten[Position[f, x_ /; x ≥ peaksize]]]
Out[1]= {1, 2, 3, 4, 36, 37, 38}
```



```
In[3]:= LinearModelFit[fp2[[All, 1]], x, x]["BestFit"]
Out[3]= -0.727273 + 3.00791 x
```



```
In[5]:= LinearModelFit[fp2[[All, 1]], x, x]
Out[5]= FittedModel[ -0.640114 + 2.89517 x ]
```

```
In[6]:= LinearModelFit[fp2[[All, 1]], x, x]["ANOVATable"]
```

	DF	SS	MS	F-Statistic	P-Value
x	1	38301.7	38301.7	11685.4	7.82079×10^{-47}
Error	36	117.999	3.27775		
Total	37	38419.7			

```
In[]:= LinearModelFit[fp2[[All, 1], x, x][["ANOVATable"]] // OutputForm
```

```
Out[=]/OutputForm=
```

	DF	SS	MS	F-Statistic	P-Value
x	1	38301.7	38301.7	11685.4	7.82079 10 ⁻⁴⁷
Error	36	117.999	3.27775		
Total	37	38419.7			

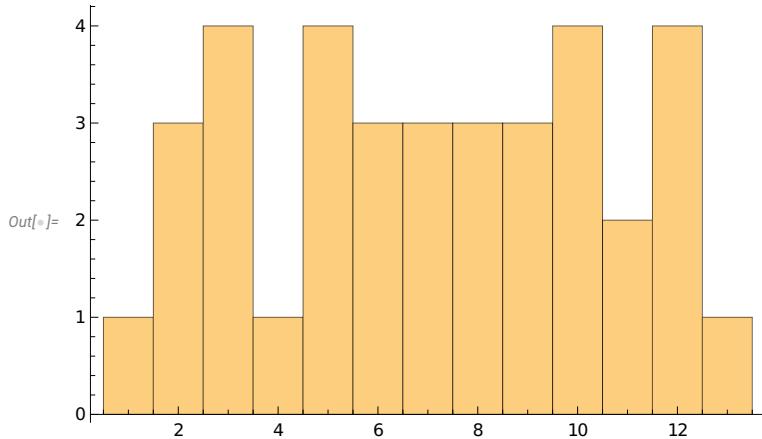
```
In[]:= bffp2 = LinearModelFit[fp2[[All, 1]] - 1, x, x][["BestFit"]]
```

```
Out[=]= -1.64011 + 2.89517 x
```

```
In[]:= FullSimplify[-1.7272727272727202` + 3.0079051383399205` x]
```

```
Out[=]= -1.72727 + 3.00791 x
```

```
In[]:= Histogram[Round[Mod[Table[-12.2607 + 8.84903 x, {x, 1, 36}], 12] + 1], 12]
```



```
In[]:= h = Table[Mod[Floor[bffp2 - 1], 12] + 1, {x, 1, 30}]
```

```
Out[=]= {1, 4, 7, 10, 1, 4, 7, 10, 1, 4, 7, 10, 1, 4, 7, 10, 1, 4, 7, 10, 1, 4, 7, 10, 1, 4}
```

```
In[]:= fp2
```

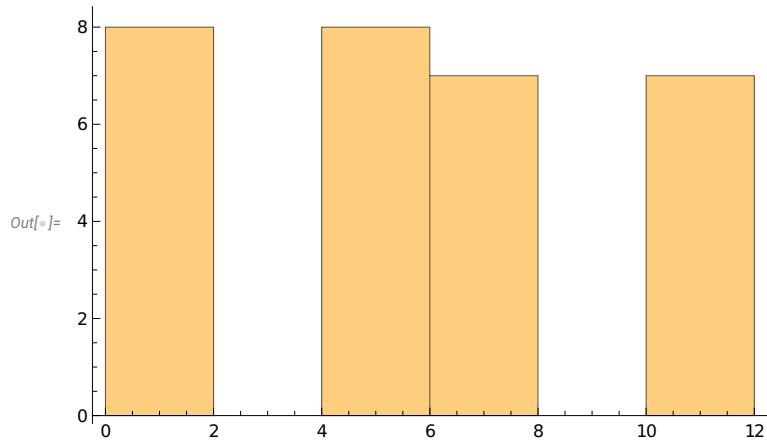
```
Out[=]= {{3, 0.0321638}, {6, 0.0313297}, {8, 0.0312456}, {12, 0.0317037}, {16, 0.0328643}, {18, 0.0310025}, {20, 0.0330454}, {24, 0.0334092}, {27, 0.0318948}, {29, 0.0320098}, {31, 0.0319791}, {34, 0.0304092}, {36, 0.0310513}, {38, 0.030888}, {43, 0.0305003}, {47, 0.0299716}, {50, 0.0312786}, {53, 0.0307197}, {58, 0.0316165}, {60, 0.0310366}, {65, 0.0305477}, {67, 0.0316617}}
```

```
In[]:= h1 = Mod[fp2[[All, 1]] - 1, 12] + 1
```

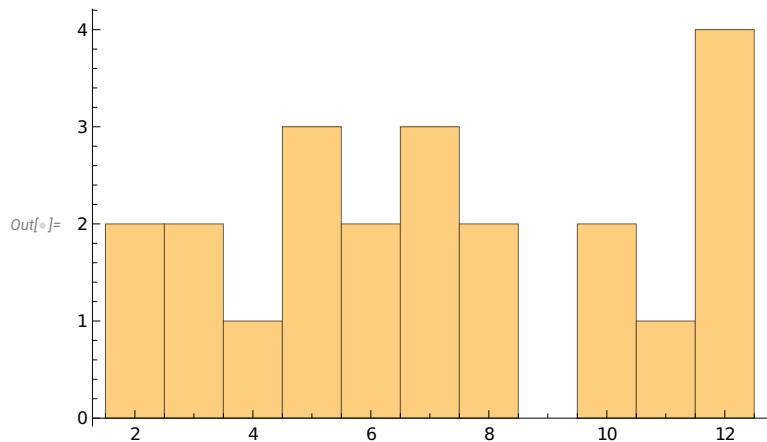
```
Out[=]= {3, 6, 8, 12, 4, 6, 8, 12, 3, 5, 7, 10, 12, 2, 7, 11, 2, 5, 10, 12, 5, 7}
```

Peaks of peaks may land in house 1, 4, 7, 10; i.e. the square houses a.k.a. kendras.

```
In[8]:= Histogram[h, 12](*modeled peaks of peaks*)
```

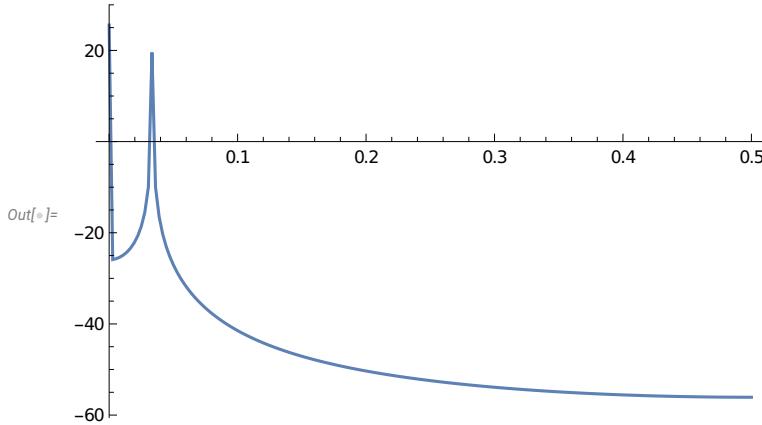


```
In[9]:= Histogram[h1, {1}](*actual peaks of peaks*)
```

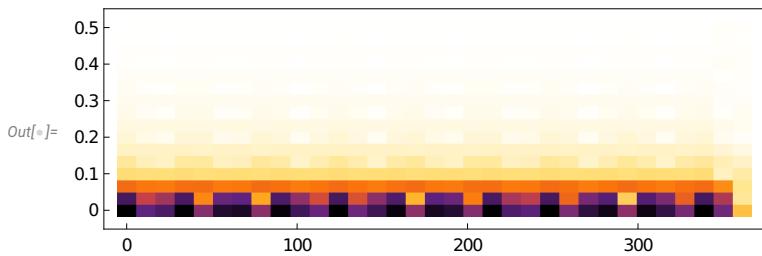


Idealized Theoretical Result

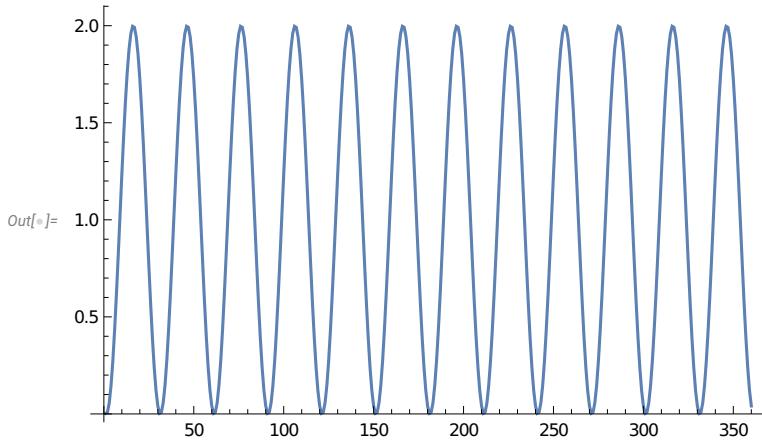
```
In[8]:= Periodogram[Table[Sin[360*(i - 30)/30] + 1, {i, 0, 2 Pi, 2 Pi/360}], PlotRange -> All]
```



```
In[9]:= Spectrogram[Table[Sin[360*(i - 30)/30] + 1, {i, 0, 2 Pi, 2 Pi/360}]]
```



```
In[10]:= ListPlot[Table[Sin[(360*(i - 30)/30)] + 1, {i, 2 Pi/360, 2 Pi, 2 Pi/360}], Joined -> True]
```

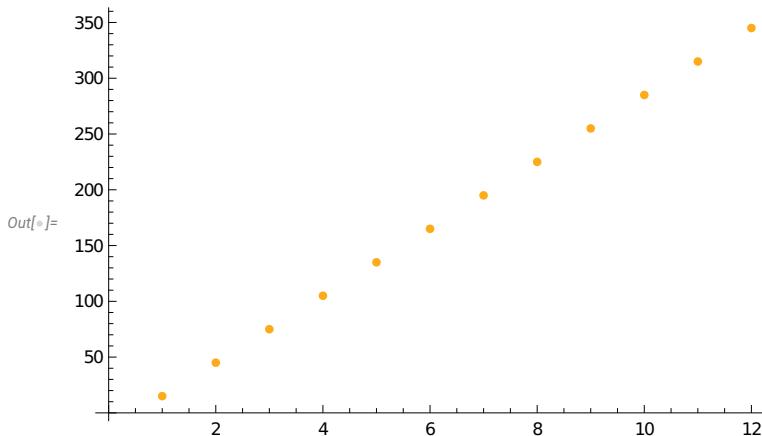


```
In[11]:= sinpeaks = FindPeaks[N[Table[Sin[(360*(i - 30)/30)] + 1, {i, 2 Pi/360, 2 Pi, 2 Pi/360}]]]
```

```
Out[11]= {{16, 1.99694}, {46, 1.99694}, {76, 1.99694}, {106, 1.99694}, {136, 1.99694}, {166, 1.99694}, {196, 1.99694}, {226, 1.99694}, {256, 1.99694}, {286, 1.99694}, {316, 1.99694}, {346, 1.99694}}
```

```
In[1]:= sinpeaks[[All, 1]] - 1
Out[1]= {15, 45, 75, 105, 135, 165, 195, 225, 255, 285, 315, 345}
```

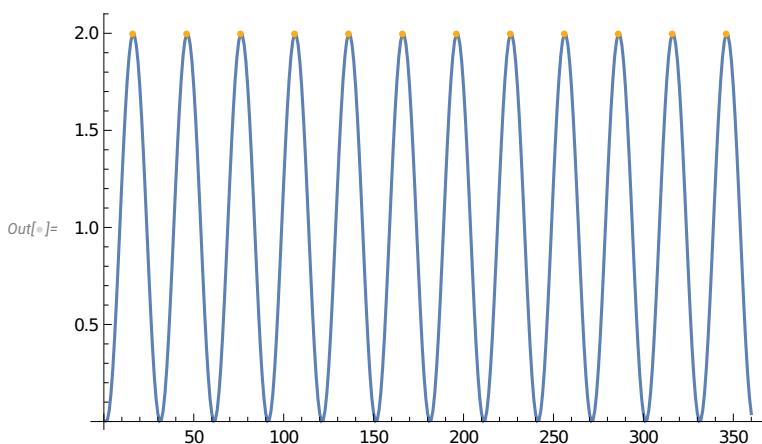
```
In[2]:= ListPlot[Style[sinpeaks[[All, 1]] - 1, colors[[1]]]]
```



```
In[3]:= LinearModelFit[sinpeaks[[All, 1]] - 1, x, x]
```

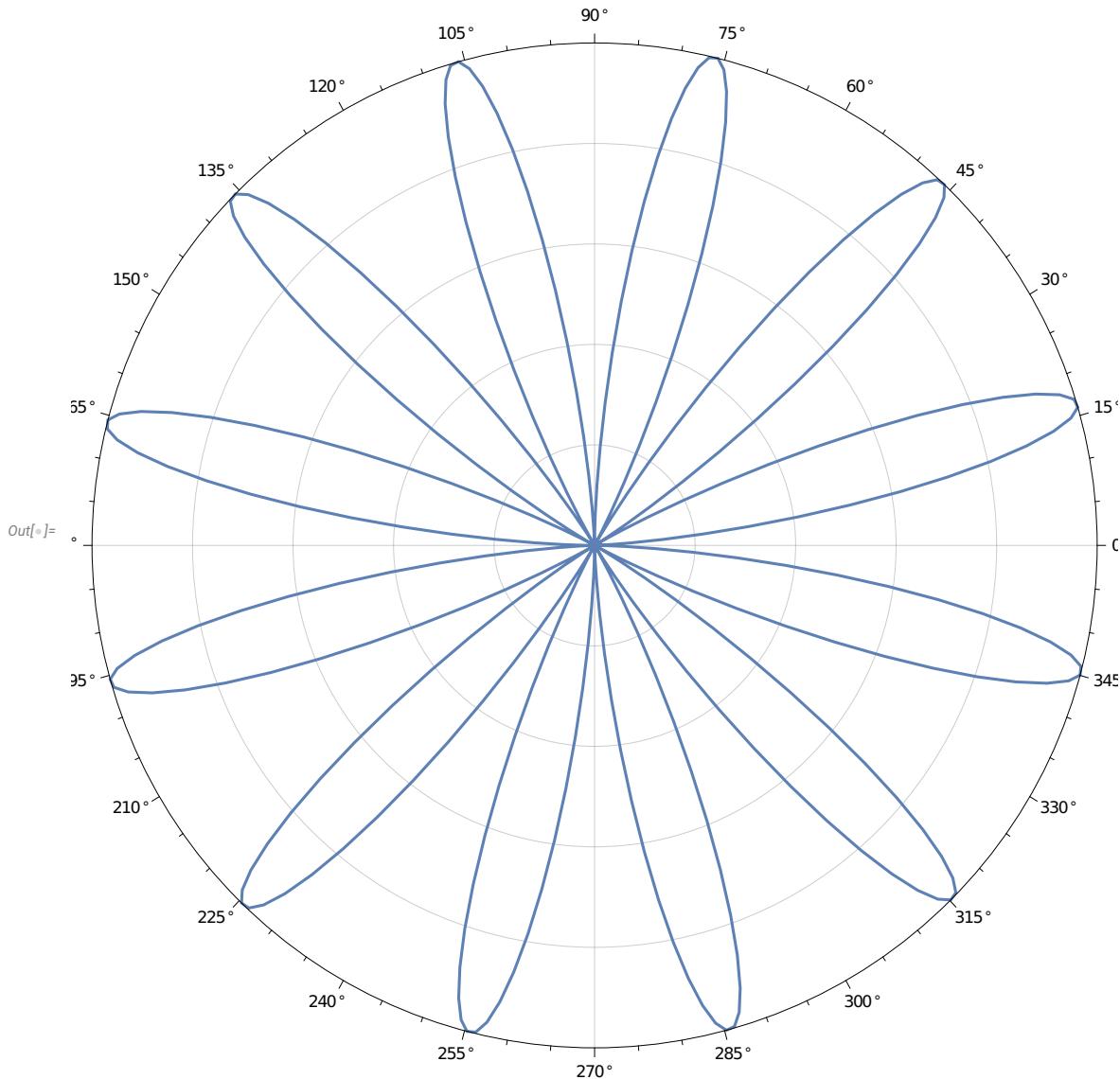
```
Out[3]= FittedModel[-15. + 30. x]
```

```
In[4]:= ListLinePlot[
{N[Table[Sin[360*(i - 30)/30] + 1, {i, 2 Pi/360, 2 Pi, 2 Pi/360}]],
 Style[sinpeaks, colors[[1]]],
 Joined → {True, False},
 PlotStyle → {Automatic, PointSize[.01]}]
```



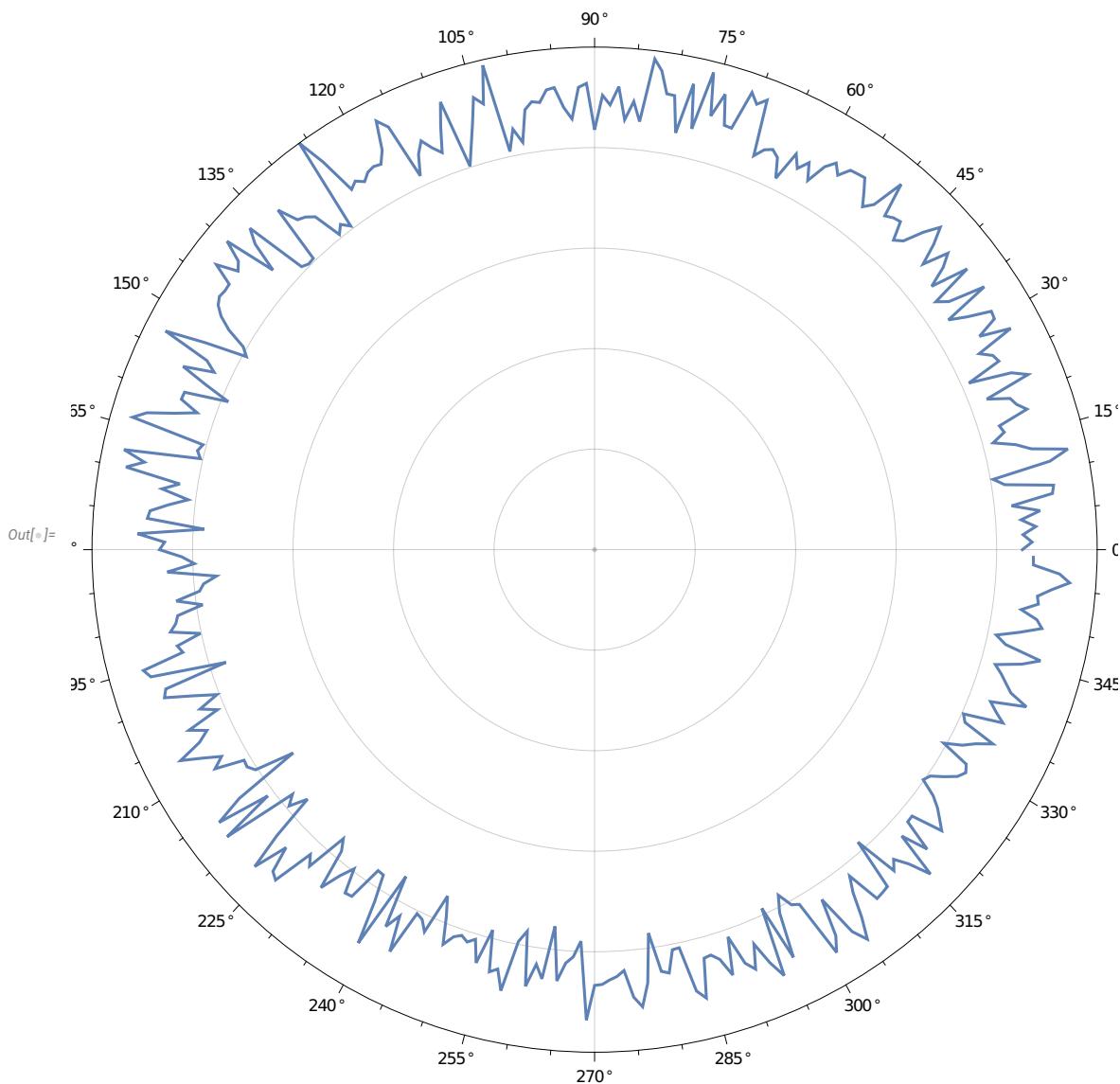
```
In[1]:= ListPolarPlot[Table[ $\sin[360 * (i - 30) / 30] + 1$ , {i, 0,  $2\pi$ ,  $2\pi/360}$ ],  
PlotLabel → "Our standard graph", PolarAxes → Automatic,  
PolarGridLines → {{0,  $\pi/2$ ,  $\pi$ ,  $3\pi/2$ }, Automatic},  
PolarTicks → {"Degrees", Automatic}(*, PlotLegends → {"True", "False", "Markers"}*),  
PlotRange → All, ImageSize → Large, Joined → True]
```

Our standard graph



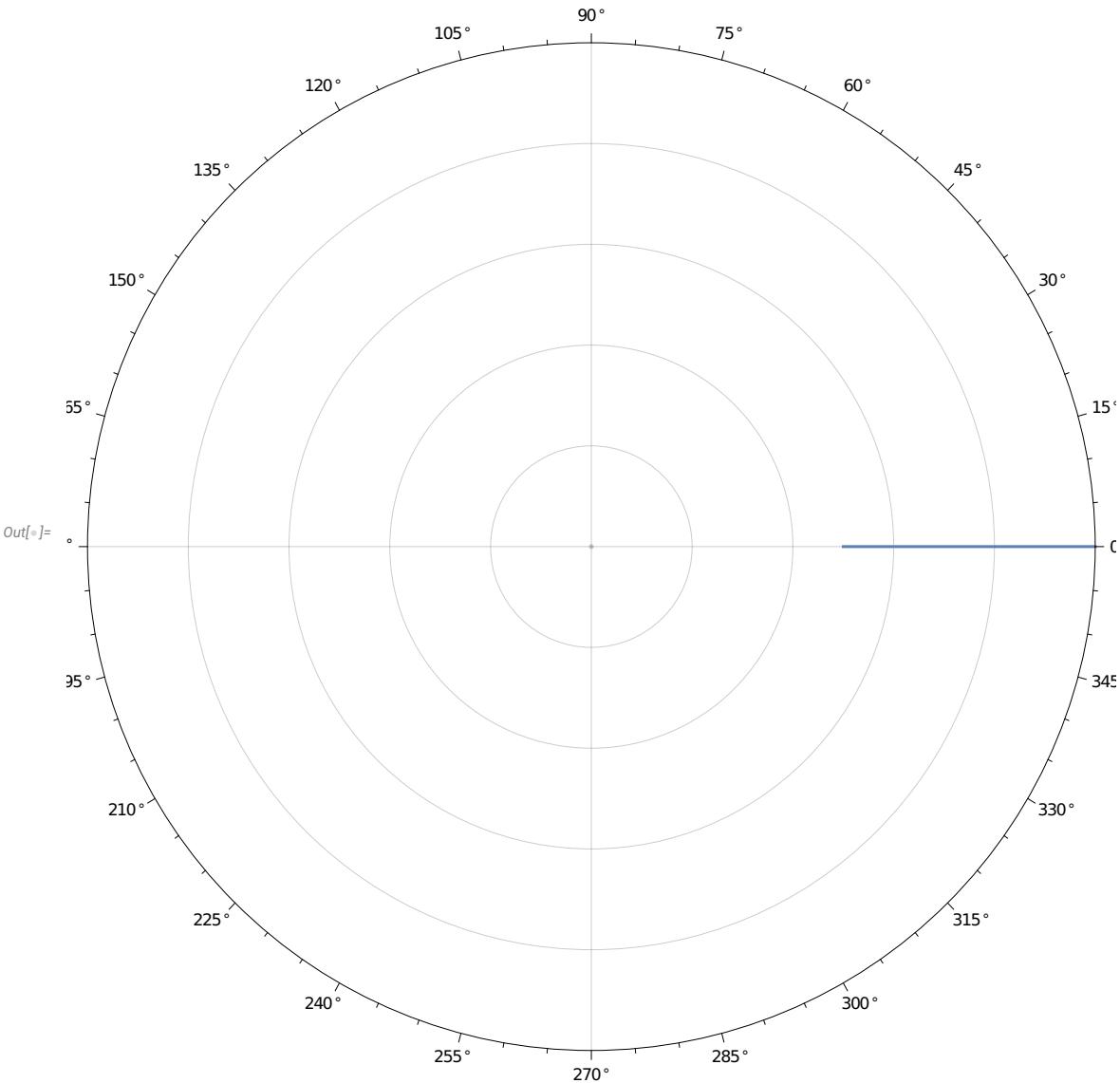
```
In[=] lpp = ListPolarPlot[data, PlotLabel -> (*TextWords[sundata[[1]][1*2]][1]<>*),
  "Average Nomalized Article Numbers & Sun Angle",
  PolarAxes -> Automatic, PolarGridLines -> {{0, Pi/2, Pi, 3Pi/2}, Automatic},
  PolarTicks -> {"Degrees", Automatic}(*, PlotLegends -> {"True", "False", "Markers"}*),
  PlotRange -> All, ImageSize -> Large, Joined -> True]
```

Average Nomalized Article Numbers & Sun Angle



```
In[1]:= ListPolarPlot[{0, 0}, PlotLabel -> "Our standard graph",
  PolarAxes -> Automatic, PolarGridLines -> {{0, Pi/2, Pi, 3Pi/2}, Automatic},
  PolarTicks -> {"Degrees", Automatic}(*, PlotLegends -> {"True", "False", "Markers"}*),
  PlotRange -> All, ImageSize -> Large, Joined -> True]
```

Our standard graph



```
In[2]:= (*ref/menuitem/PublishToCloud*)
```

Visualize Angles

```
In[]:= fibo = {21.25, 34.38, 42.49, 47.51, 55.62, 68.75,
           84.98, 111.25, 124.38, 132.49, 137.51, 145.62, 158.75, 174.98}

Out[=] {21.25, 34.38, 42.49, 47.51, 55.62, 68.75, 84.98,
        111.25, 124.38, 132.49, 137.51, 145.62, 158.75, 174.98}

In[=]:= (*asteroidnames=Import["asteroid sample 1200 names.m"];*)

In[=]:= halves = N[Table[(360 i/2), {i, 2-1}]]

Out[=] {180.}

In[=]:= thirds = N[Table[(360 i/3), {i, 3-1}]]

Out[=] {120., 240.}

In[=]:= squares = N[Table[360 i/4, {i, 4-1}]]

Out[=] {90., 180., 270.}

In[=]:= fifths = N[Table[360 i/5, {i, 5-1}]]

Out[=] {72., 144., 216., 288.}

In[=]:= sixths = N[Table[360 i/6, {i, 6-1}]]

Out[=] {60., 120., 180., 240., 300.}

In[=]:= sevenths = N[Table[360 i/7, {i, 7-1}]]

Out[=] {51.4286, 102.857, 154.286, 205.714, 257.143, 308.571}

In[=]:= eighths = N[Table[360 i/8, {i, 8-1}]]

Out[=] {45., 90., 135., 180., 225., 270., 315.}

In[=]:= ninths = N[Table[360 i/9, {i, 9-1}]]

Out[=] {40., 80., 120., 160., 200., 240., 280., 320.}

In[=]:= tenths = N[Table[360 i/10, {i, 10-1}]]

Out[=] {36., 72., 108., 144., 180., 216., 252., 288., 324.}

In[=]:= elevenths = N[Table[360 i/11, {i, 11-1}]]

Out[=] {32.7273, 65.4545, 98.1818, 130.909,
       163.636, 196.364, 229.091, 261.818, 294.545, 327.273}
```

```

In[]:= twelfths = N[Table[360 i/12, {i, 12 - 1}]]
Out[]= {30., 60., 90., 120., 150., 180., 210., 240., 270., 300., 330.}

In[]:= thirteenths = N[Table[360 i/13, {i, 13 - 1}]]
Out[=] {27.6923, 55.3846, 83.0769, 110.769, 138.462,
166.154, 193.846, 221.538, 249.231, 276.923, 304.615, 332.308}

In[]:= fourteenths = N[Table[360 i/14, {i, 14 - 1}]]
Out[=] {25.7143, 51.4286, 77.1429, 102.857, 128.571, 154.286,
180., 205.714, 231.429, 257.143, 282.857, 308.571, 334.286}

In[]:= fifteenths = N[Table[360 i/15, {i, 15 - 1}]]
Out[=] {24., 48., 72., 96., 120., 144., 168., 192., 216., 240., 264., 288., 312., 336.}

In[]:= sixteenths = N[Table[360 i/16, {i, 16 - 1}]]
Out[=] {22.5, 45., 67.5, 90., 112.5, 135., 157.5,
180., 202.5, 225., 247.5, 270., 292.5, 315., 337.5}

In[]:= seventeenths = N[Table[360 i/17, {i, 17 - 1}]]
Out[=] {21.1765, 42.3529, 63.5294, 84.7059, 105.882, 127.059, 148.235, 169.412,
190.588, 211.765, 232.941, 254.118, 275.294, 296.471, 317.647, 338.824}

In[]:= eighteenths = N[Table[360 i/18, {i, 18 - 1}]]
Out[=] {20., 40., 60., 80., 100., 120., 140., 160.,
180., 200., 220., 240., 260., 280., 300., 320., 340.}

In[]:= angletypes = {halves, thirds, squares, fifths, sixths,
sevenths, eighths, ninths, tenths, elevenths, twelfths, thirteenths,
fourteenths, fifteenths, sixteenths, seventeenths, eighteenths, fibo};

In[]:= anglenames =
{"halves", "thirds", "squares", "fifths", "sixths", "sevenths", "eights",
"ninth", "tenths", "elevenths", "twelfths", "thirteenths", "fourteenths",
"fifteenths", "sixteenths", "seventeenths", "eighteenths", "fibonacci"};

```

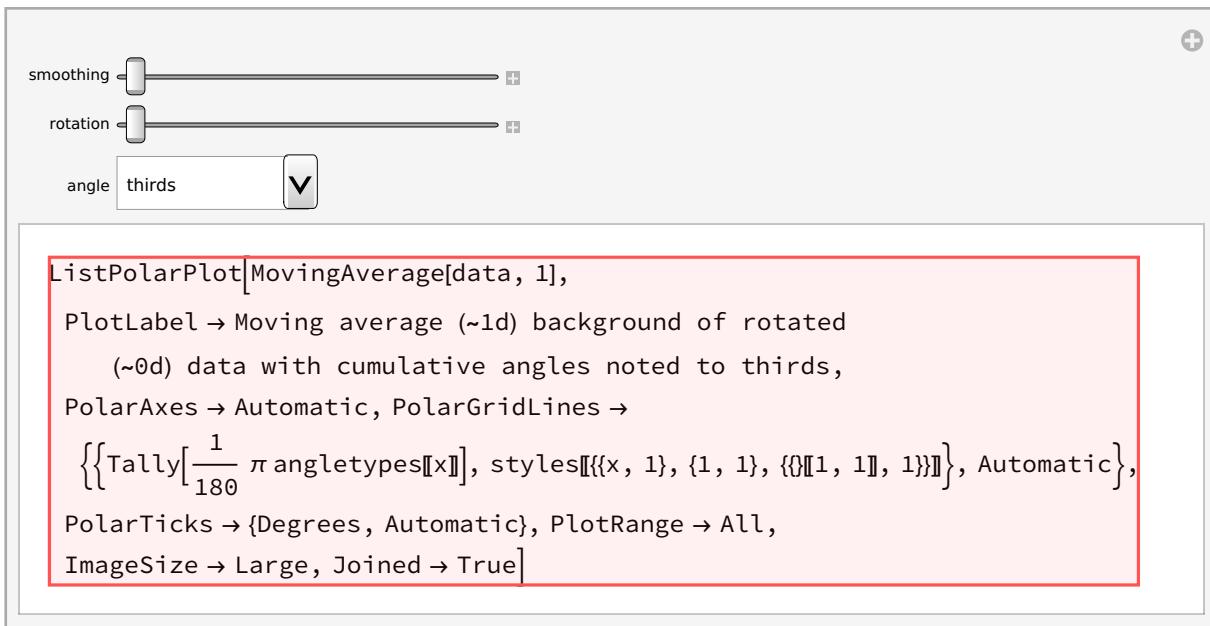
Play with sliders.

```
In[8]:= Manipulate[
 ListPolarPlot[RotateRight[(*Join[ConstantArray[0, c], *)MovingAverage[data, smoothing]
 (*]), rotation], PlotLabel -> "Moving average (~" <> ToString[smoothing] <>
 "d) background of rotated (~" <> ToString[rotation] <> "d) data with " <>
 "angle<> " angles noted", PolarAxes -> Automatic, PolarGridLines ->
 {angletypes[[Position[anglenames, angle][[1]]][1]*2*Pi/360, Automatic},
 PolarTicks -> {"Degrees", Automatic}(*,PlotLegends -> {"True", "False", "Markers"}*),
 PlotRange -> All, ImageSize -> Large, Joined -> True],
 {smoothing, 1, 20, 1}, {rotation, 0, 10, 1}, {angle, anglenames}]
```

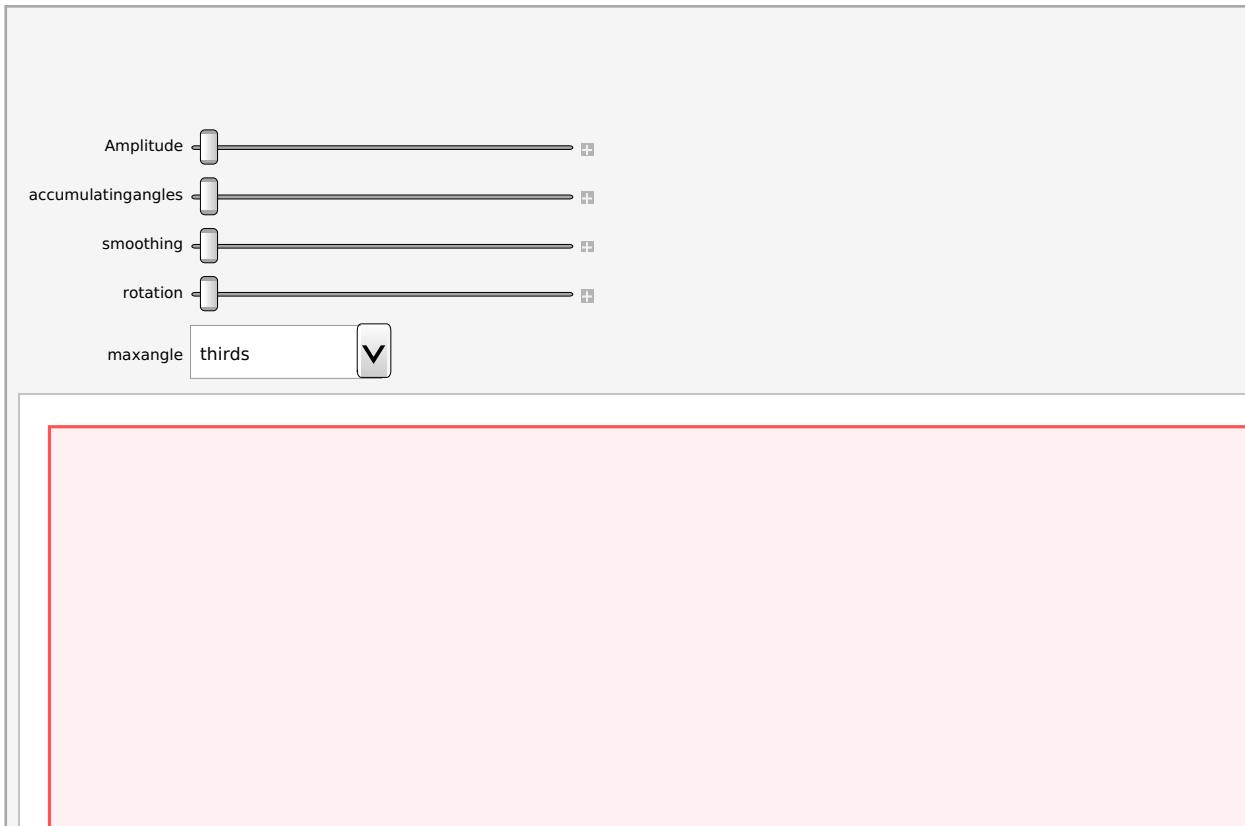
```
Out[8]= ListPolarPlot[MovingAverage[data, 1],
 PlotLabel -> Moving average (~1d) background
 of rotated (~0d) data with halves angles noted,
 PolarAxes -> Automatic, PolarGridLines -> {angletypes \frac{\pi}{180}, Automatic},
 PolarTicks -> {Degrees, Automatic},
 PlotRange -> All, ImageSize -> Large, Joined -> True]
```

```
In[9]:= styles = {█, █, █, █, █, █, █, █, █};
```

```
In[8]:= Manipulate[
  ListPolarPlot[RotateRight[(*Join[ConstantArray[0, c], *)MovingAverage[data, smoothing]
  (*]), rotation], PlotLabel → "Moving average (~" <> ToString[smoothing] <>
  "d) background of rotated (~" <> ToString[rotation] <>
  "d) data with cumulative angles noted to " <> angle, PolarAxes → Automatic,
  PolarGridLines → {Transpose[{Tally[Flatten[Join[Table[angletypes[[x]] * 2 * Pi / 360,
  {x, 1, Position[anglenames, angle][[1, 1]]}]]][All, 1]],
  styles[[Tally[Flatten[Join[Table[angletypes[[x]] * 2 * Pi / 360,
  {x, 1, Position[anglenames, angle][[1, 1]]}]]][All, 2]]}], Automatic},
  PolarTicks → {"Degrees", Automatic}(*, PlotLegends → {"True", "False", "Markers"}*),
  PlotRange → All,
  ImageSize → Large,
  Joined → True],
  {smoothing, 1, 20, 1}, {rotation, 0, 10, 1},
  {angle, anglenames[[2 ;; -2]]}]
```



```
In[=]: Manipulate[Show[PolarPlot[
  Amplitude * Total[Table[Sin[360 * (x - i)/(360 / i)] + 1, {i, 1, accumulatingangles}]],
  {x, 0, 2 Pi}, PolarAxes → Automatic, PlotStyle → Green,
  PolarTicks → None(*{"Degrees", Automatic})*)(*,
  PlotLegends → {"True", "False", "Markers"}*), PlotRange → All, ImageSize → Large],
ListPolarPlot[RotateRight[(*Join[ConstantArray[0, c], *)
  MovingAverage[data, smoothing](*)*), rotation], PlotLabel →
  "Moving average (~" <> ToString[smoothing] <> "d) background of rotated (~" <>
  ToString[rotation] <> "d) data with cumulative angles noted to " <> maxangle,
  PolarAxes → Automatic, PolarGridLines → {Transpose[{Tally[Flatten[Join[Table[
    angletypes[[x]] * 2 * Pi / 360, {x, 1, Position[anglenames, maxangle][[1, 1]]}]]][[All, 1]],
    styles[[Tally[Flatten[Join[Table[angletypes[[x]] * 2 * Pi / 360,
      {x, 1, Position[anglenames, maxangle][[1, 1]]}]]][[All, 2]]]]], Automatic},
    PolarTicks → {"Degrees", Automatic}(*, PlotLegends → {"True", "False", "Markers"}*),
    PlotRange → All, ImageSize → Large, Joined → True]]],
{Amplitude, 0, .0005, .00001},
{accumulatingangles,
  1, 359, 1},
{smoothing, 1, 20, 1}, {rotation, -10, 10, 1},
{maxangle, anglenames[[2 ;; -2]]}]
```



Out[8]=

Show[

PlotLabel → Moving average (~1d) background of rotated (~10d) data with cumulative distribution of angles, PolarAxes → Automatic, PolarGridLines → $\left\{ \text{Tally}\left[\frac{1}{180} \pi \text{angletypes}[x]\right], \text{styles}[[x, 1]] \right\}$, PolarTicks → {Degrees, Automatic}, PlotRange → All, ImageSize → Large, Joined → True

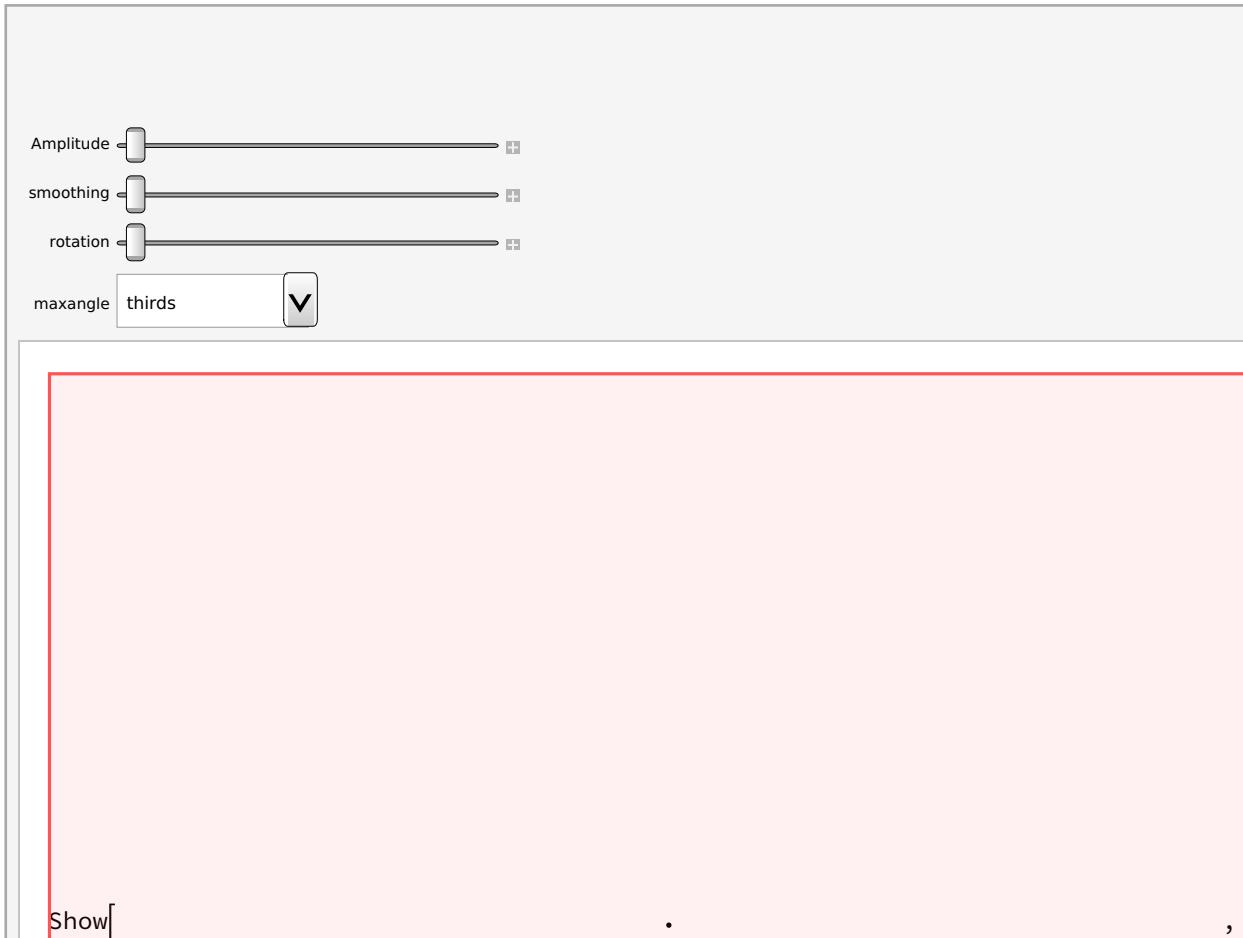
More documentation will be added in the coming days

In[8]:= (*CloudExport[sundata, "CSV", "MinorPlanetSunData", Permissions → "Public"]*)

In[9]:= Table[2^n, {n, 9}]

Out[9]= {2, 4, 8, 16, 32, 64, 128, 256, 512}

```
In[=] Manipulate[
  Show[PolarPlot[Amplitude * Total[Table[Sin[360 * (x - i)/(360 / i)] + 1, {i, {30, 52, 90}}]], 
    {x, 0, 2 Pi}, PolarAxes → Automatic, PlotStyle → Green,
    PolarTicks → None, PlotRange → All, ImageSize → Large],
  ListPolarPlot[RotateRight[(*Join[ConstantArray[0, c], *)]
    MovingAverage[data, smoothing](*), rotation], PlotLabel →
    "Moving average (~" <> ToString[smoothing] <> "d) background of rotated (~" <>
    ToString[rotation] <> "d) data with cumulative angles noted to " <> maxangle,
    PolarAxes → Automatic, PolarGridLines → {Transpose[{Tally[Flatten[Join[Table[
      angletypes[[x]] * 2 * Pi / 360, {x, 1, Position[anglenames, maxangle][[1, 1]]}]]][[All, 1]],
      styles[[Tally[Flatten[Join[Table[angletypes[[x]] * 2 * Pi / 360,
        {x, 1, Position[anglenames, maxangle][[1, 1]]}]]][[All, 2]]]]], Automatic},
    PolarTicks → {"Degrees", Automatic}(*, PlotLegends → {"True", "False", "Markers"})*),
    PlotRange → All, ImageSize → Large, Joined → True]],
  {Amplitude, 0, .005, .00001}, {smoothing, 1, 20, 1},
  {rotation, -10, 10, 1},
  {maxangle, anglenames[[2 ;; -2]]}]
```



Out[=]=

```
Show[
```

```

PlotLabel → Moving average (~1d) background of rotated (~10d) data with cumulative
PolarAxes → Automatic, PolarGridLines → {Tally[ $\frac{1}{180} \pi \text{angletypes}[x]$ ], styles[[{x, 1},
PolarTicks → {Degrees, Automatic}, PlotRange → All, ImageSize → Large, Joined → True

```

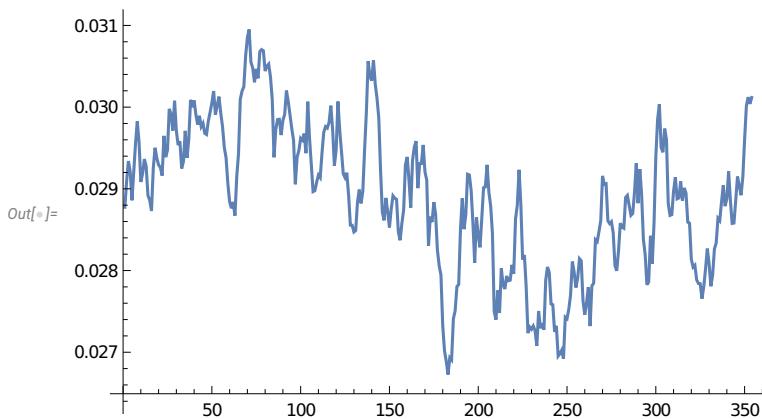
```

In[1]:= ListCorrelate
Out[1]= ListCorrelate

In[2]:= crossCorrelation[tsX_, tsY_, shift_] ?QuantityQ :=
Module[{μX = Mean@tsX, σX = StandardDeviation@tsX, μY = Mean@tsY,
σY = StandardDeviation@tsY, tsYShift, xValues, yValues, minLength, pairs},
tsYShift = TimeSeriesShift[tsY, shift];
xValues = Select[tsX["Path"], #[1] ≤ tsYShift["LastTime"] &][All, 2];
yValues = Select[tsYShift["Path"], #[1] ≥ tsX["FirstTime"] &][All, 2];
minLength = Min[Length /@ {xValues, yValues}];
pairs = Transpose[{xValues[[;; minLength]], yValues[[;; minLength]]}];
Last[FoldList[Function[{running, next}, running + (next[[1]] - μX)(next[[2]] - μY)],
0, pairs]]/(minLength σX σY)]

```

```
In[1]:= ListLinePlot[MovingAverage[data, 7]]
```



```
In[2]:= tsmf = TimeSeriesModelFit[data]
```

```
Out[2]= TimeSeriesModel[ Family: AR  
Order: {1}]
```

```
In[3]:= Normal[tsmf]
```

```
Out[3]= ARProcess[0.0210518, {0.271989}, 2.48644 × 10-6]
```

```
In[4]:= tsmf2 = TimeSeriesModelFit[MovingAverage[data, 7]]
```

```
Out[4]= TimeSeriesModel[ Family: ARMA  
Order: {1, 1}]
```

```
In[5]:= Normal[tsmf2]
```

```
Out[5]= ARMAProcess[0.00210344, {0.927238}, {0.313959}, 8.56379 × 10-8]
```

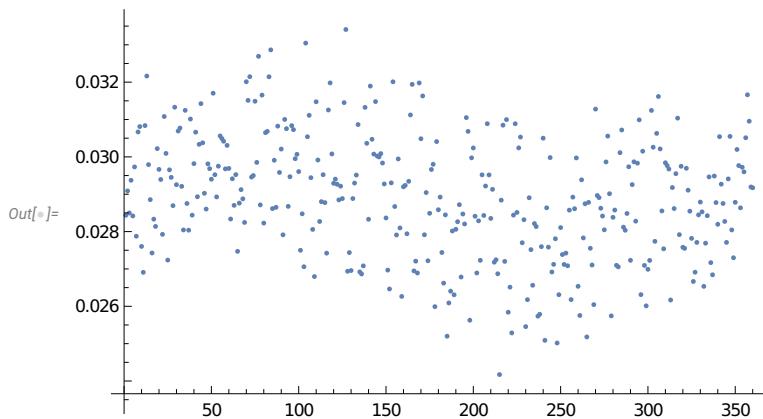
```
In[6]:= WeakStationarity[ARProcess[0.00184093, {1.05832, -0.119514}, 9.19056 × 10-8]]
```

```
Out[6]= True
```

```
In[7]:= CorrelationFunction[ARProcess[0.00184093, {1.05832, -0.119514}, 9.19056 × 10-8], {0, 100}]
```

```
Out[7]= TimeSeries[ Time: 0 to 100  
Data points: 101]
```

In[1]:= **ListPlot[data]**



In[2]:= **WeakStationarity[ARProcess[0.0216588, {0.281963}, 2.64669 \times 10^-6]]**

Out[2]= **True**

In[3]:= **CovarianceFunction[Normal[tsmf], s, t]**

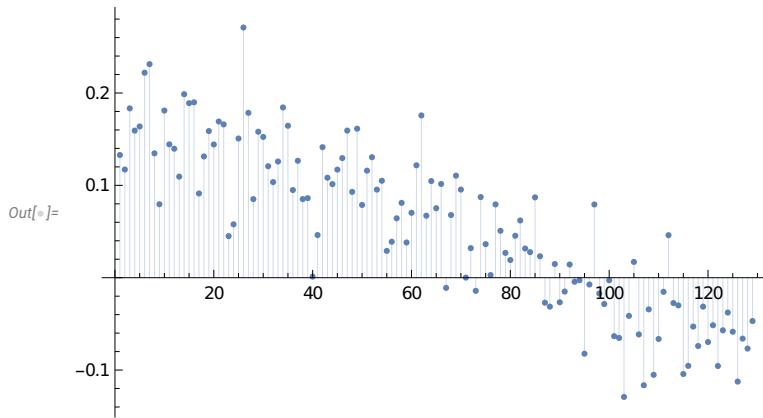
Out[3]= **$2.68508 \times 10^{-6} \times 0.271989^{\text{Abs}[s-t]}$**

In[4]:= **eproc = EstimatedProcess[data, Normal[tsmf]]**

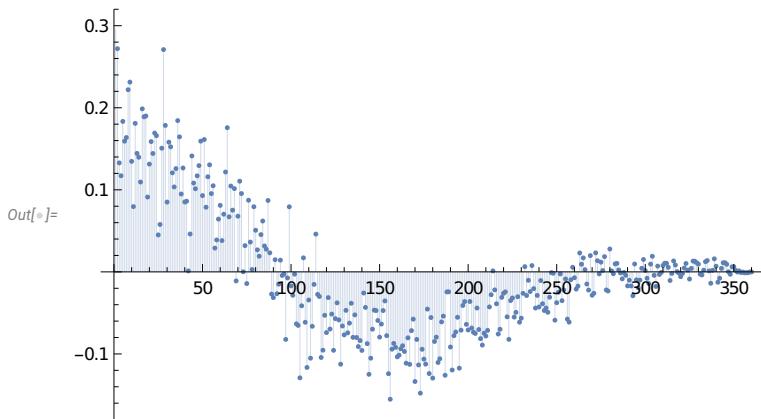
Out[4]= **ARProcess[0.0210518, {0.271989}, 2.48644 \times 10^-6]**

In[5]:= **(*ListPlot[TemporalData[CorrelationFunction[#, {359}]&/@{data, eproc}],
Filling\rightarrow{1\rightarrow{2}}, PlotStyle\rightarrowPointSize[Medium], PlotLegends\rightarrow{"Data", "Model"}]*)**

In[6]:= **ListPlot[CorrelationFunction[data, {2, 130}], Filling \rightarrow 0, PlotRange \rightarrow All]**



```
In[1]:= ListPlot[CorrelationFunction[data, {359}], Filling -> 0(*, PlotRange -> All*)]
```

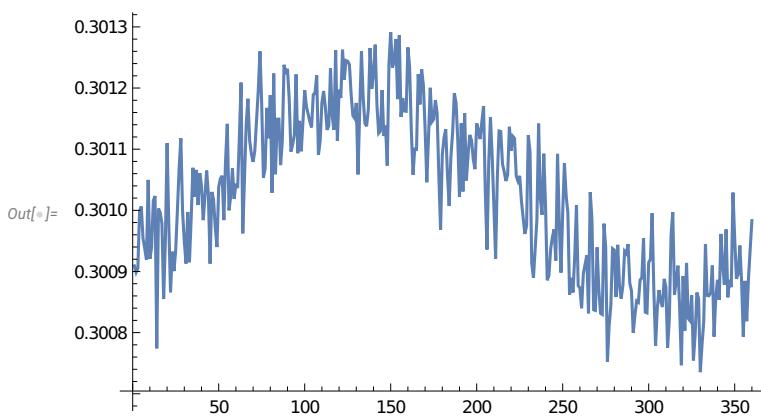


```
In[2]:= ListPlot[CorrelationFunction[#, {10}], PlotLabel -> Head[#], Filling -> 0] & /@ candidates
```

```
Out[2]= candidates
```

<https://reference.wolfram.com/language/guide/Wavelets.html>

```
In[3]:= ListLinePlot[ListConvolve[data, data, {1, 1}]](* Autocorrelation*)
```



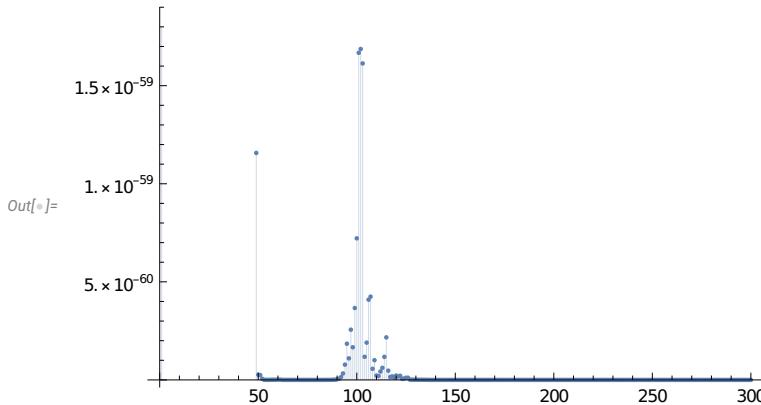
```
In[4]:= AutocorrelationTest[data]
```

```
Out[4]= 4.53681 × 10-13
```

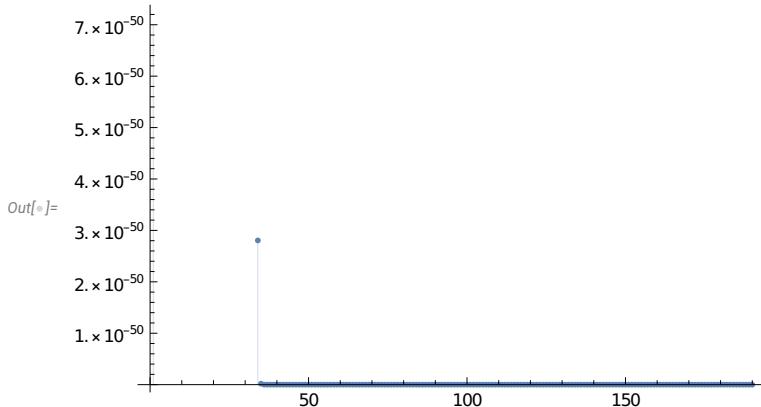
```
In[5]:= Table[AutocorrelationTest[data, i], {i, 20}]
```

```
Out[5]= {2.19348 × 10-7, 5.94288 × 10-8, 2.45687 × 10-8, 2.70887 × 10-10, 1.26845 × 10-11, 4.53681 × 10-13, 3.2275 × 10-16, 1.09275 × 10-19, 1.77508 × 10-20, 2.18975 × 10-20, 2.65556 × 10-22, 2.52247 × 10-23, 2.98179 × 10-24, 1.28123 × 10-24, 4.56319 × 10-27, 3.08164 × 10-29, 1.92264 × 10-31, 1.53524 × 10-31, 2.5221 × 10-32, 1.01259 × 10-33}
```

```
In[6]:= ListPlot[Table[AutocorrelationTest[data, i], {i, 1, 300}],  
  Filling -> Axis(*, PlotRange -> All*)]
```

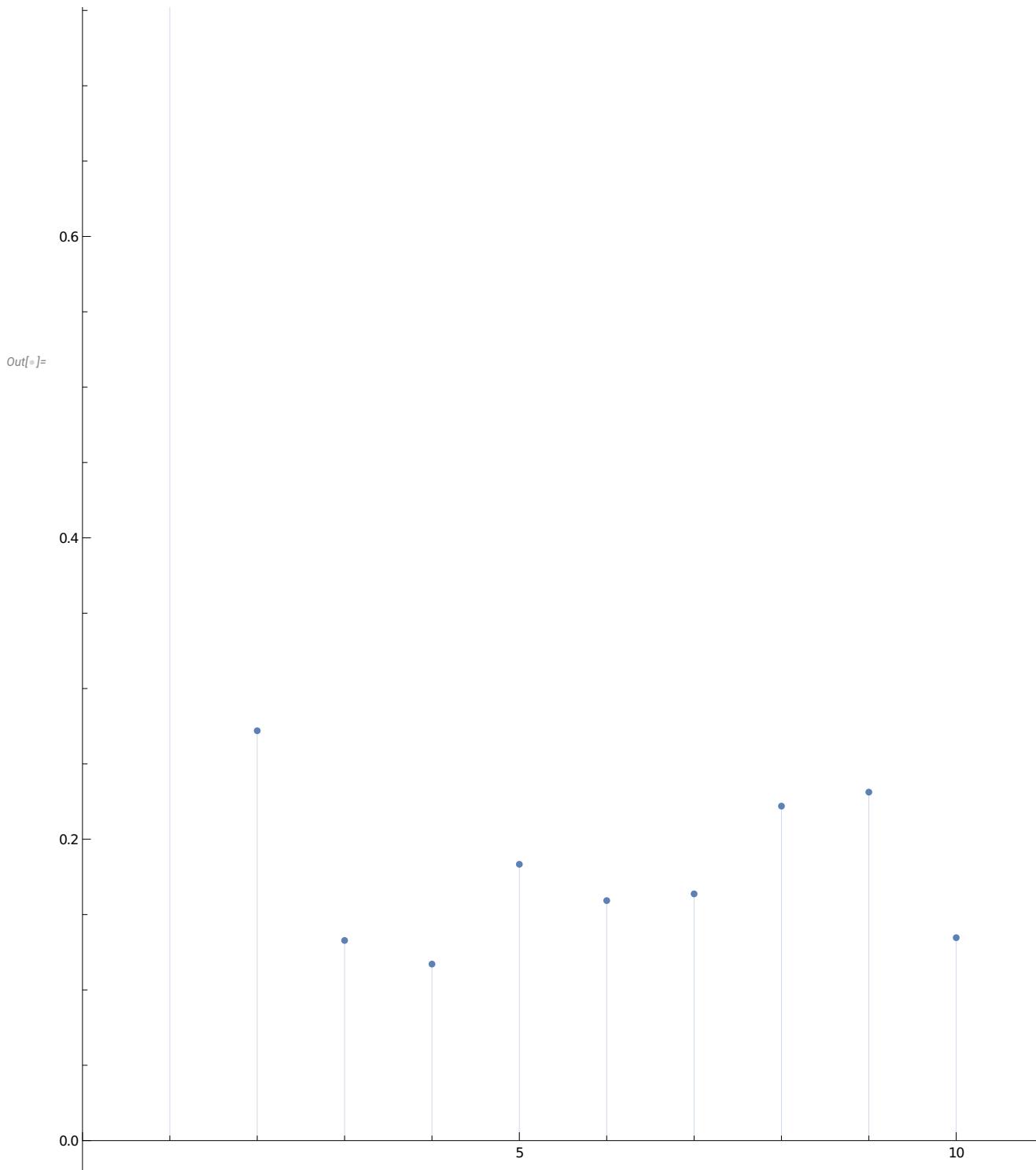


```
In[6]:= ListPlot[Table[AutocorrelationTest[data, i], {i, 1, 190}],  
  Filling -> Axis(*, PlotRange -> All*)]
```



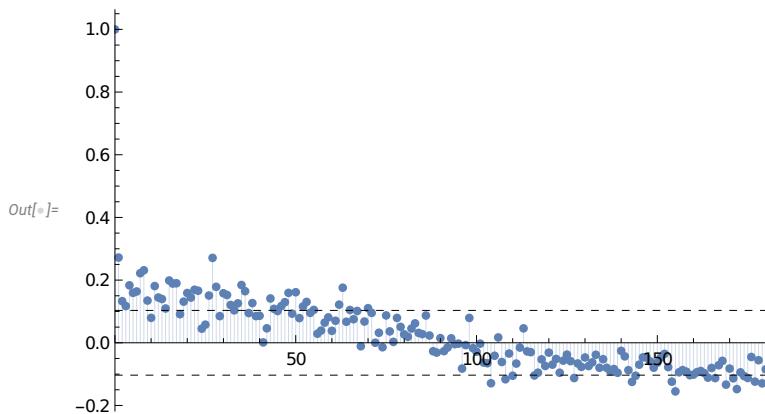
```
In[6]:= ListPlot[CorrelationFunction[data, {0, 30}], Filling -> Axis,  
PlotRange -> {{0, 30}, All}, PlotStyle -> PointSize[Medium]]
```





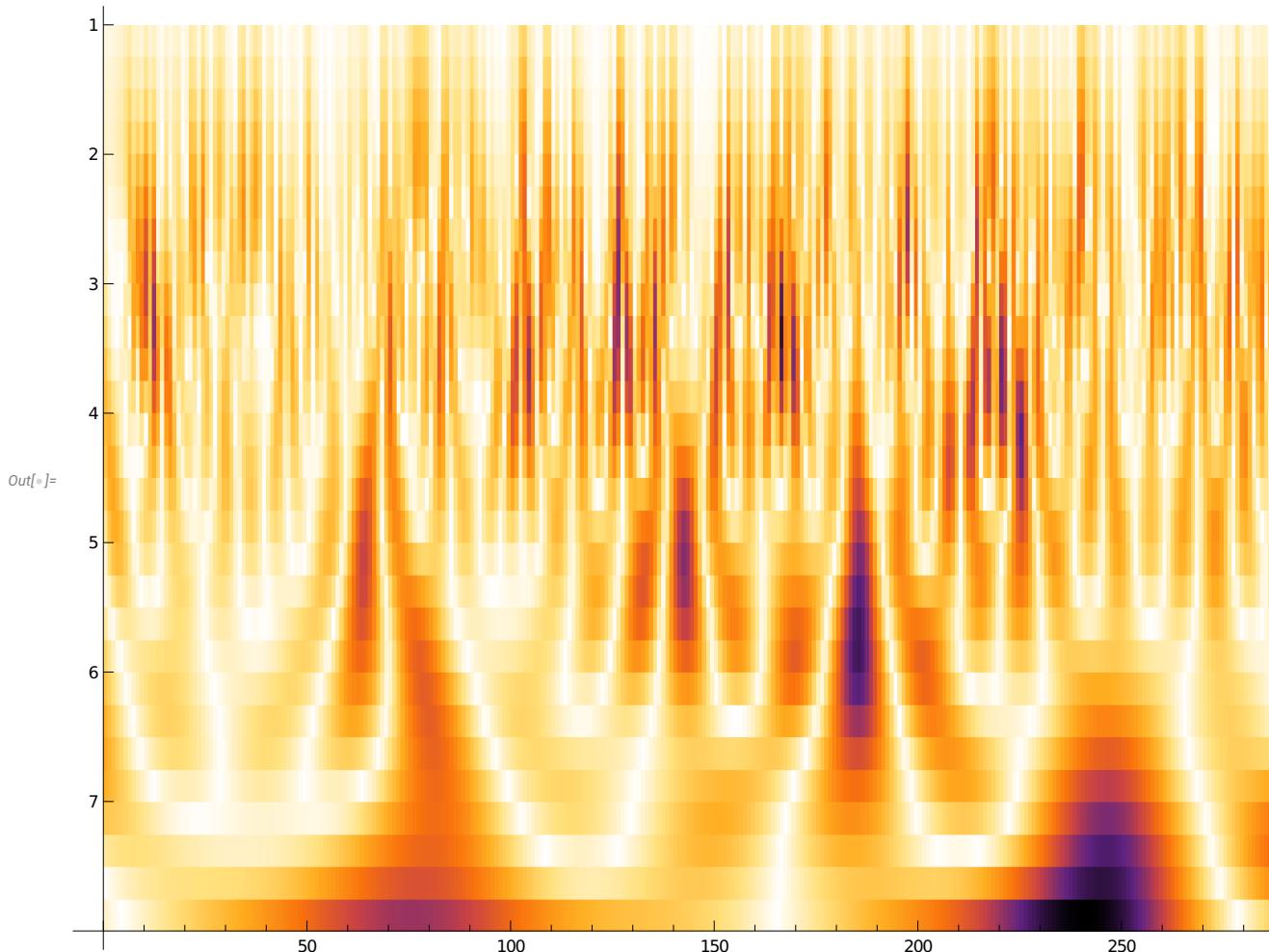
```
In[ $\circ$ ]:= acf[data_, lmax_, clev_ : 0.95] :=
  Show[ListPlot[CorrelationFunction[data, {0, lmax}], Filling -> Axis,
    PlotRange -> {{0, lmax}, All}, PlotStyle -> PointSize[Medium]],
  Graphics[{Dashed, Line[{{0, #}, {lmax, #}}]}] & /@ (Quantile[NormalDistribution[],
    {(1 - clev)/2, 1 - (1 - clev)/2}]/Sqrt[data["PathLengths"][[1]]])]
```

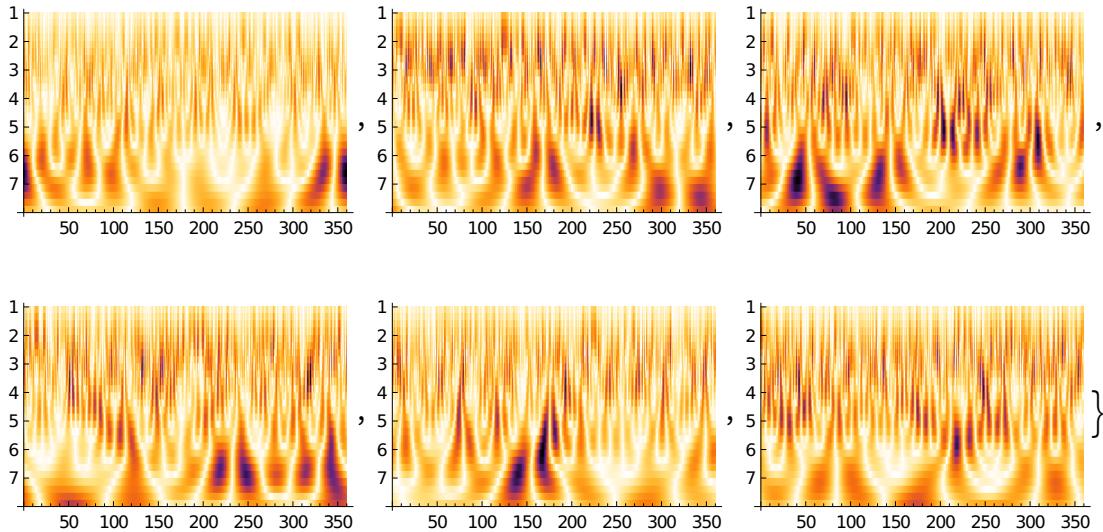
```
In[*= acf[TimeSeries[data], 180, .95]
```



Reasons why we can't go down to one hundredths of a degree: I suspect that precision largely does not reflect the multi-day process of the news publication cycle, also sampling errors would be too high. Both are good reasons to avoid it.

```
In[*= WaveletScalogram[ContinuousWaveletTransform[data]]
```





In[8]:= **WaveletScalogram[cwd, {1 | 2 | 3 | 4, _}]**

••• **WaveletScalogram**: First argument cwd to WaveletScalogram should be a DiscreteWaveletData or ContinuousWaveletData object.

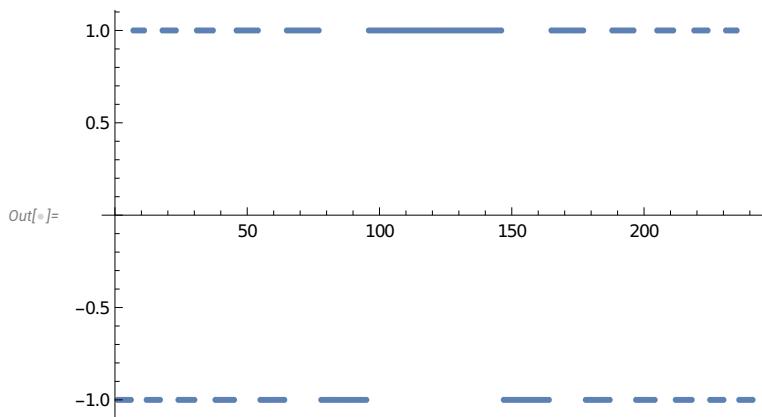
Out[8]= **WaveletScalogram[cwd, {1 | 2 | 3 | 4, _}]**

In[9]:= **WaveletScalogram[cwd, {1 | 2 | 3 | 4 | 5, _}]**

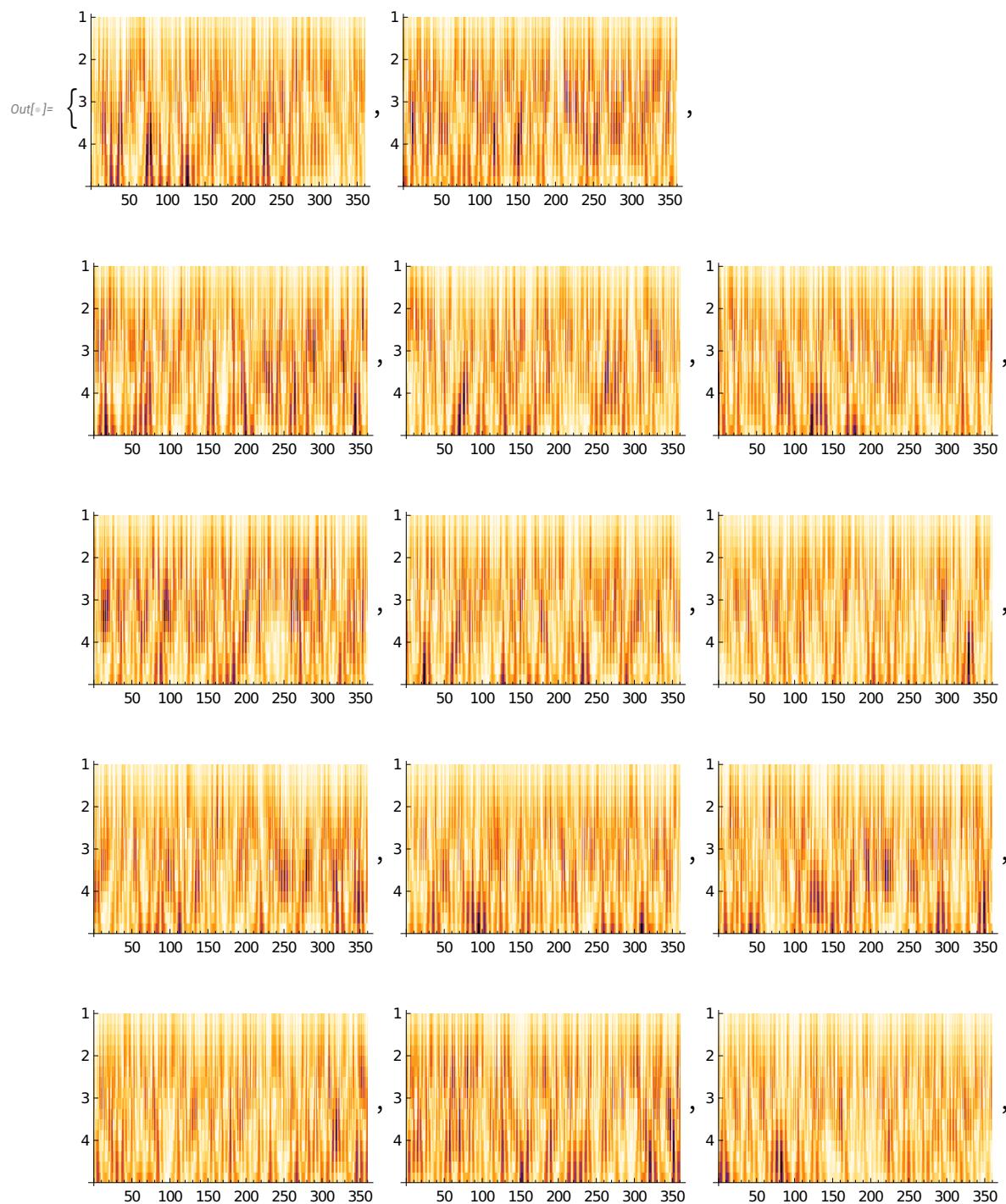
••• **WaveletScalogram**: First argument cwd to WaveletScalogram should be a DiscreteWaveletData or ContinuousWaveletData object.

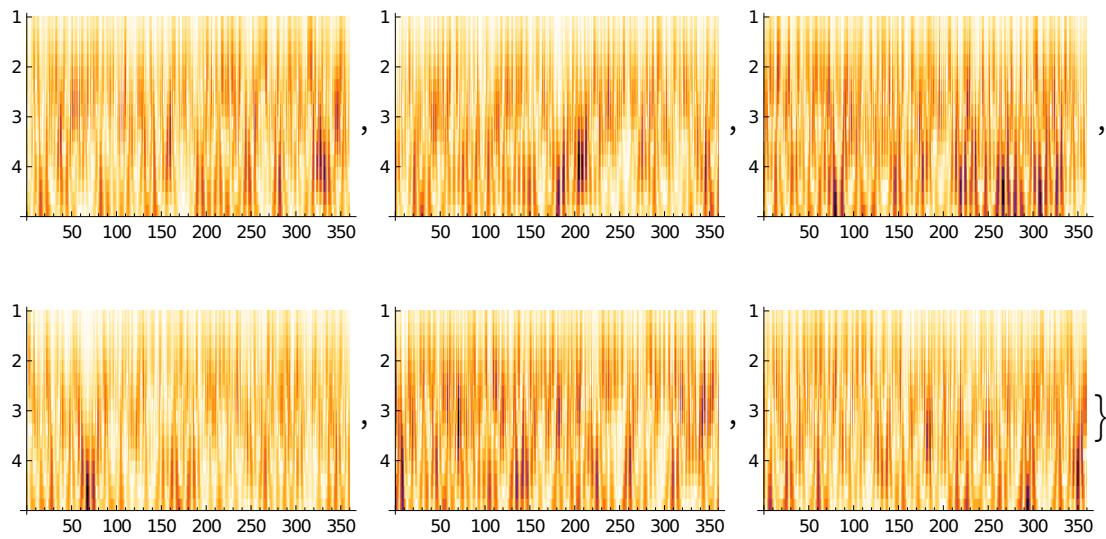
Out[9]= **WaveletScalogram[cwd, {1 | 2 | 3 | 4 | 5, _}]**

In[10]:= **ListPlot[Table[Sign[Cos[x^2]], {x, -6, 6, 0.05}]]**



In[11]:= **Table[WaveletScalogram[ContinuousWaveletTransform[**
Table[RandomReal[{Min[data], Max[data]}], 360]], {1 | 2 | 3 | 4, _}], {i, 20}]

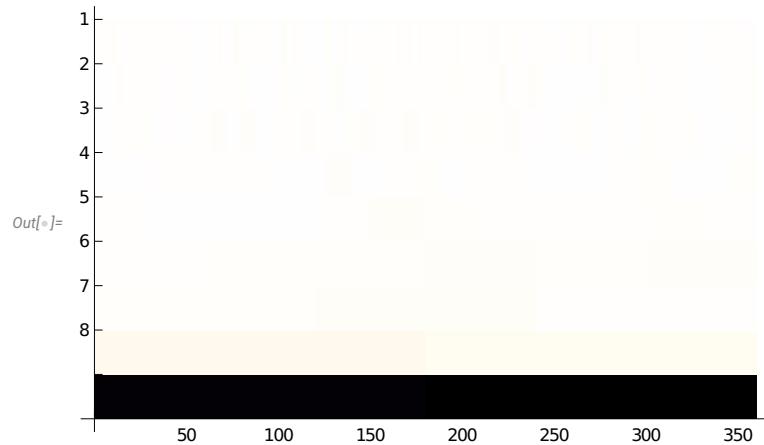




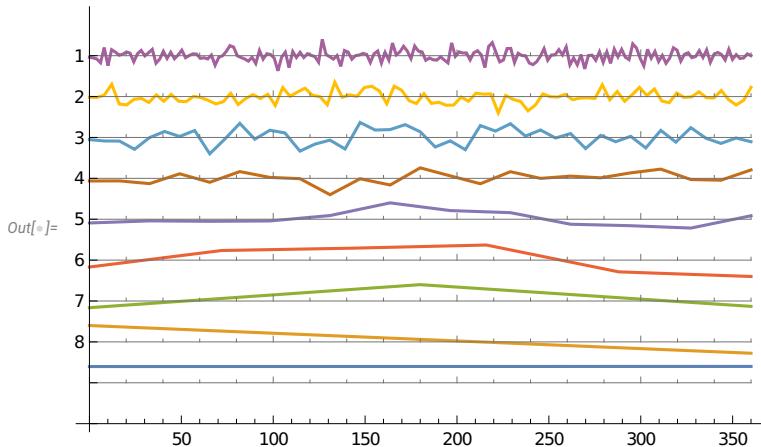
In[8]:= **dwd = DiscreteWaveletTransform[data]**

Out[8]= DiscreteWaveletData[Data dimensions: {360}]
Refinements: 8

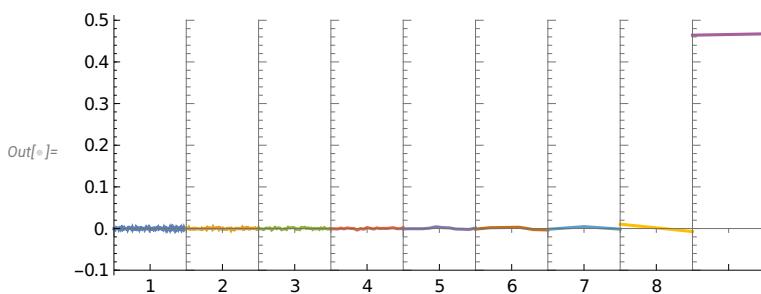
In[9]:= **WaveletScalogram[dwd]**



In[1]:= WaveletListPlot[dwd]



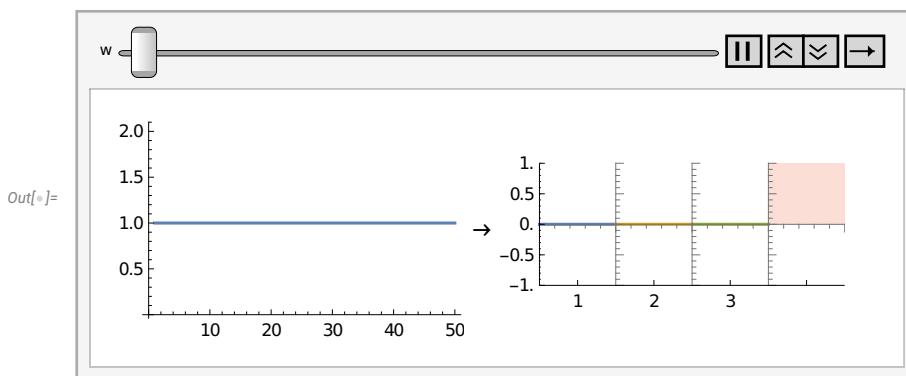
Out[1]= WaveletListPlot[dwd, PlotLayout -> "CommonYAxis"]



In[2]:= Animate[d = Cos[w Range[50]];

ListLinePlot[d] -> WaveletListPlot[

StationaryWaveletTransform[d, DaubechiesWavelet[], 3], PlotLayout -> "CommonYAxis",
PlotRange -> 1, Filling -> Axis, AspectRatio -> 1/GoldenRatio], {w, 0, \pi}]



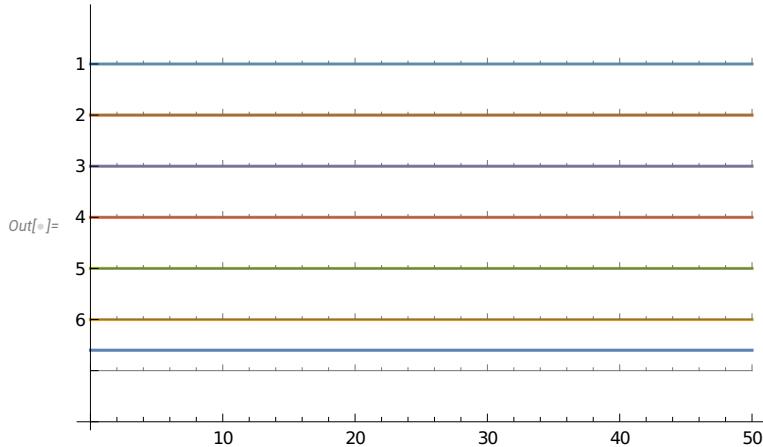
```
In[1]:= 
ListLinePlot[d] →
WaveletListPlot[StationaryWaveletTransform[d], PlotLayout → "CommonYAxis",
(*PlotRange→1,*)Filling → Axis, AspectRatio → 1/GoldenRatio]

Out[1]=
```

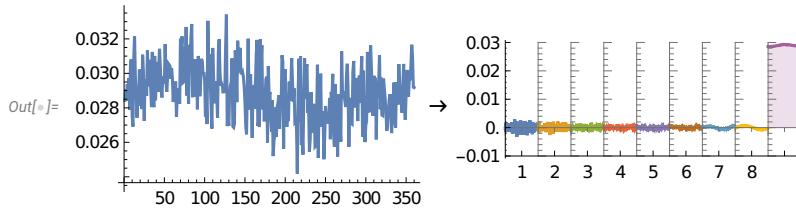
```
In[2]:= cwd = ContinuousWaveletTransform[data]
```

```
Out[2]= ContinuousWaveletData[ + Octaves: 7 Voices: 4 ]
Data points: 360 ]
```

```
In[3]:= WaveletListPlot[StationaryWaveletTransform[d]]
```



```
In[4]:= d = data;
ListLinePlot[d] →
WaveletListPlot[StationaryWaveletTransform[d], PlotLayout → "CommonYAxis",
(*PlotRange→1,*)Filling → Axis, AspectRatio → 1/GoldenRatio]
```

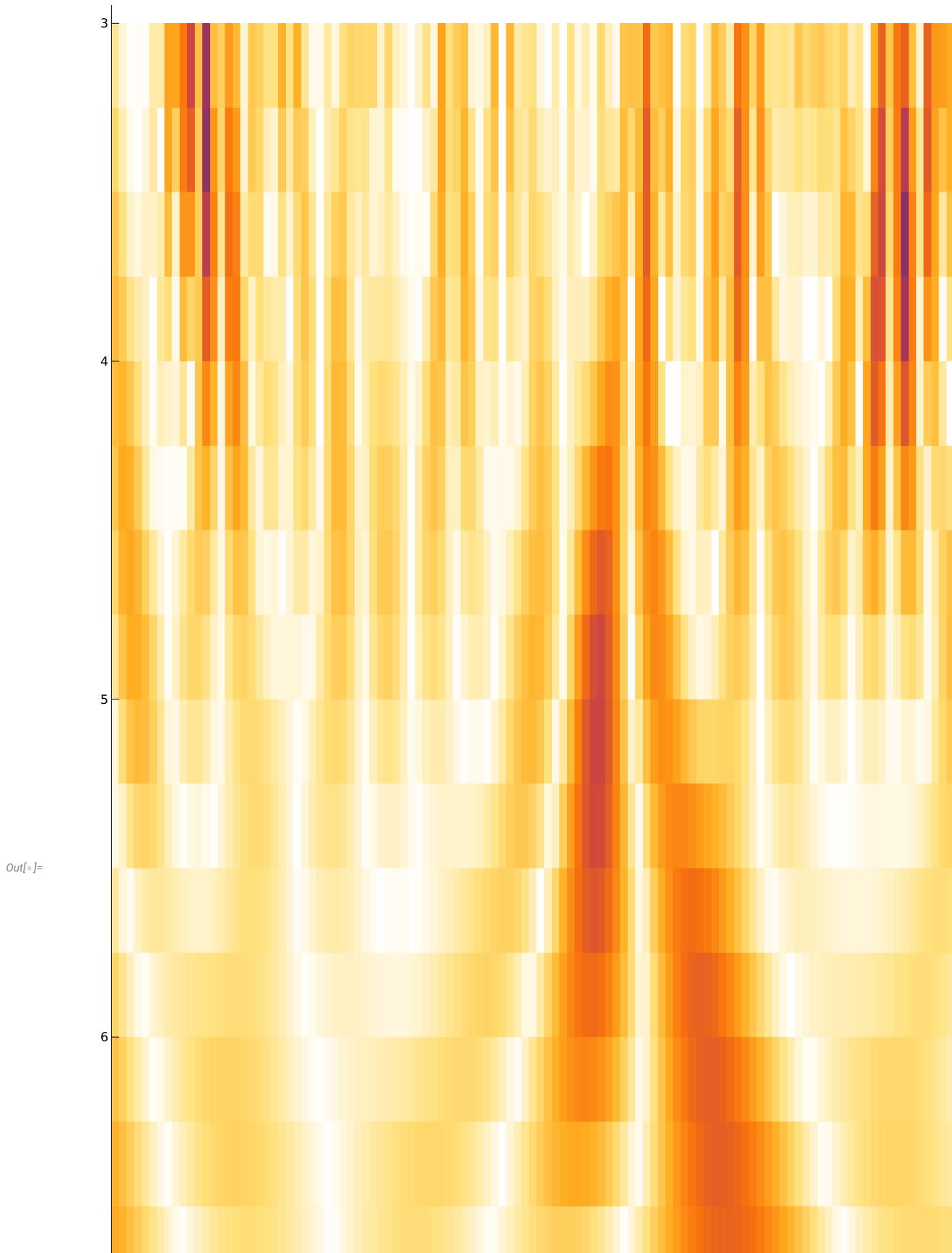


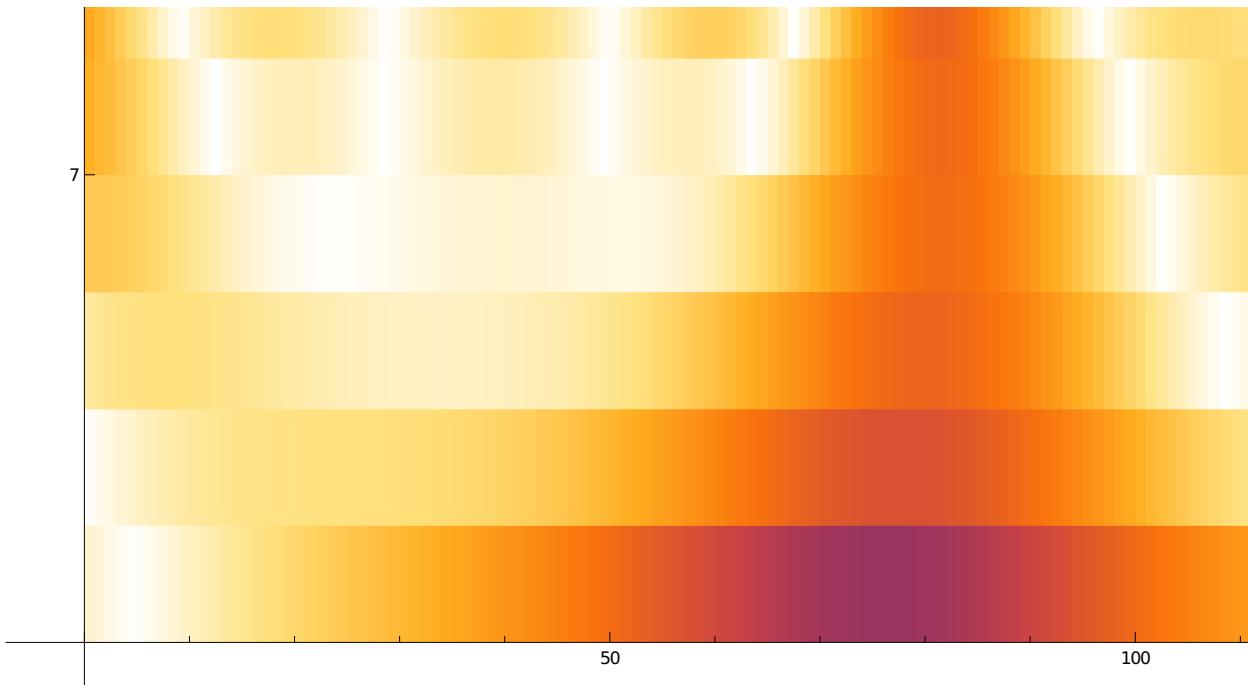
```
In[5]:= freq = (#1[[1]] → 8192/#1[[2]] &) /@ cwd["Scales"];
```

```
In[6]:= 
```

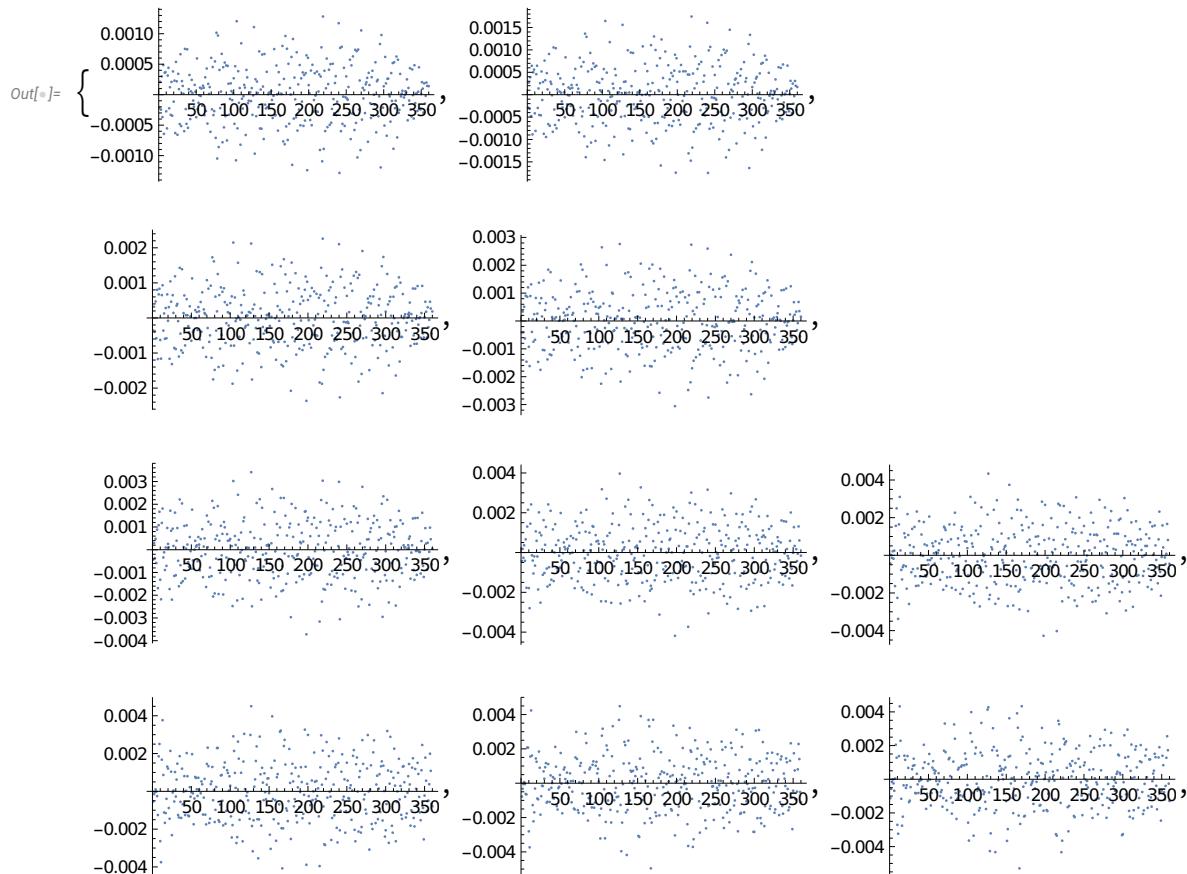
```
In[7]:= WaveletScalogram[cwd, {3 | 4 | 5 | 6 | 7, _}]
```

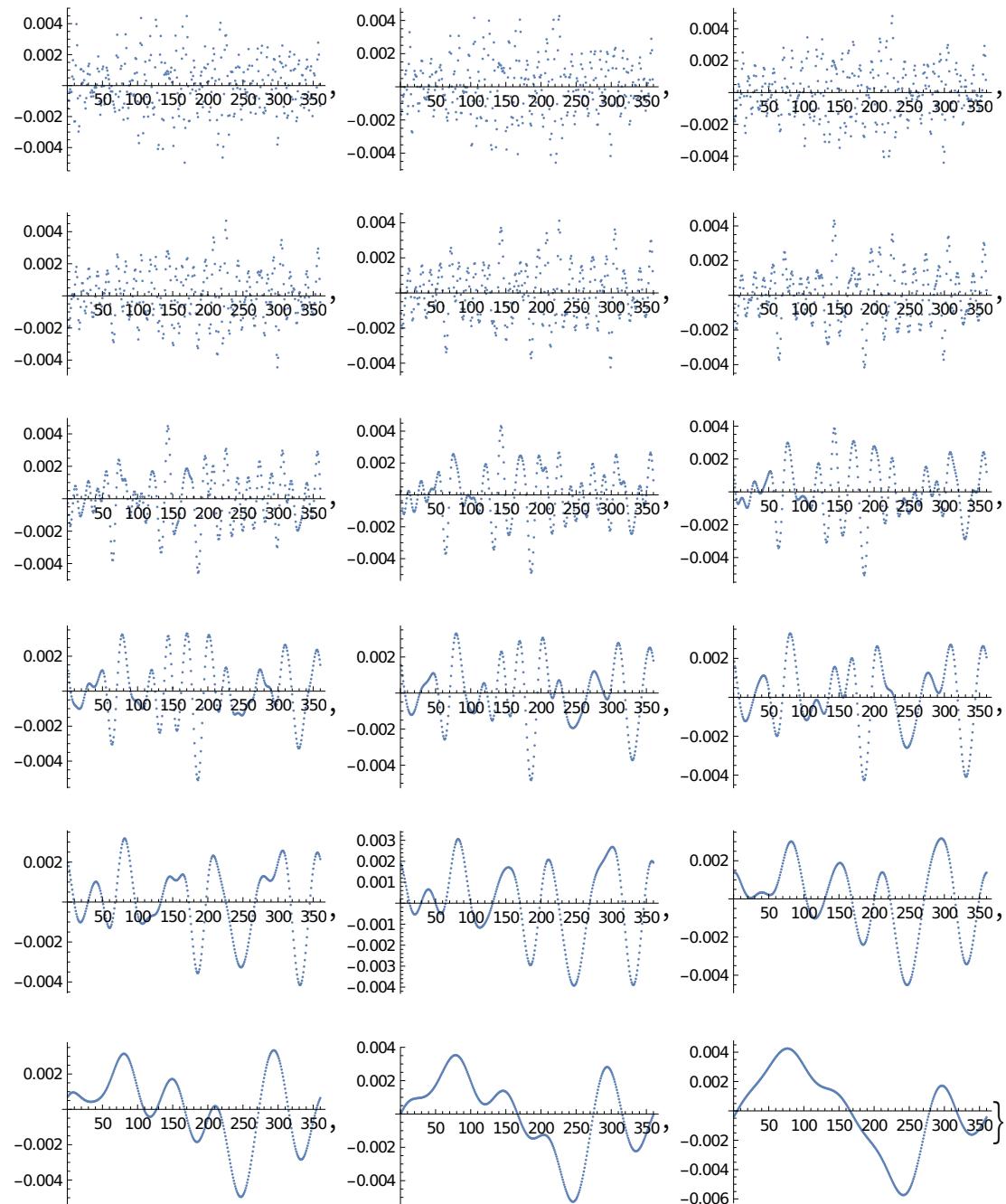
```
|
```



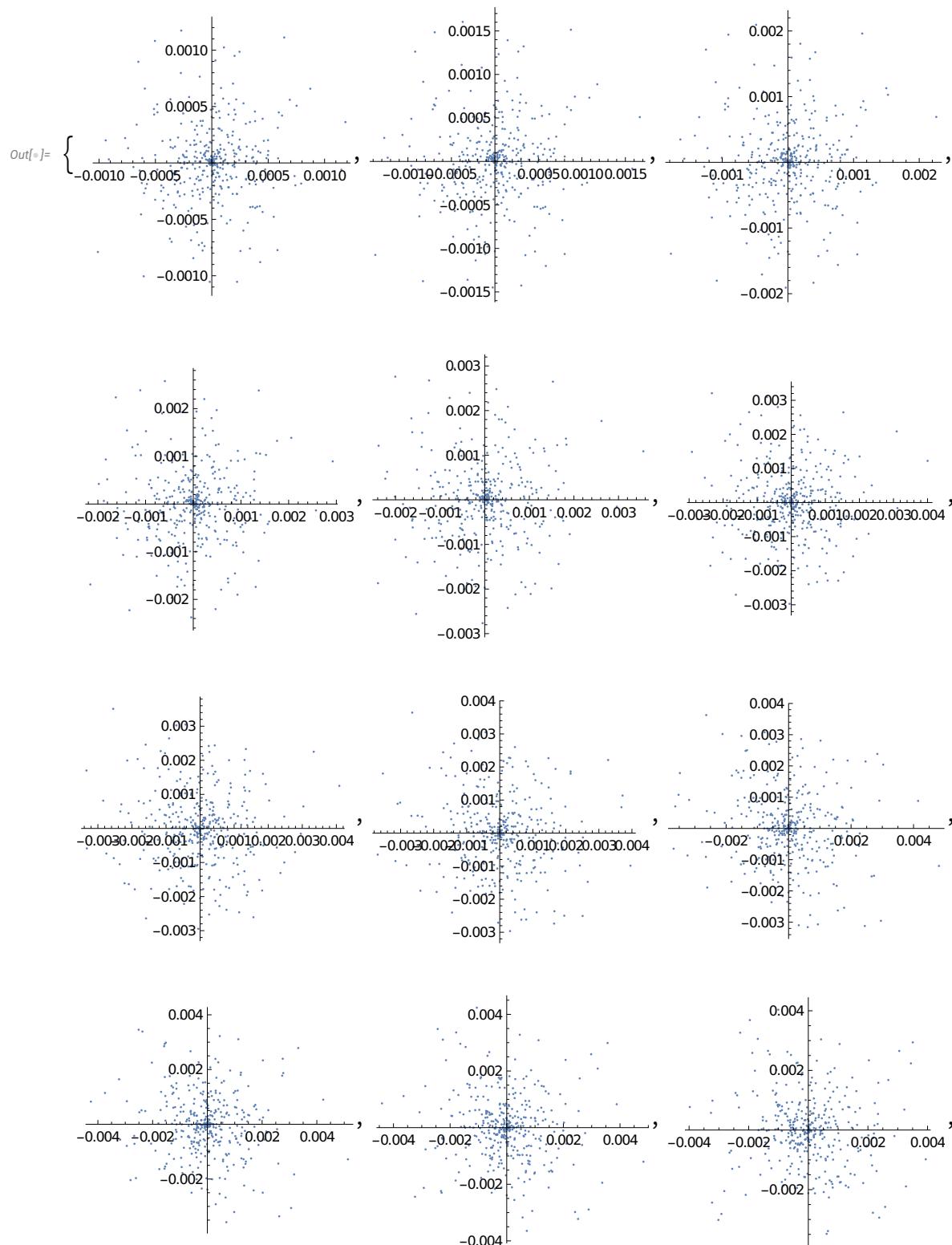


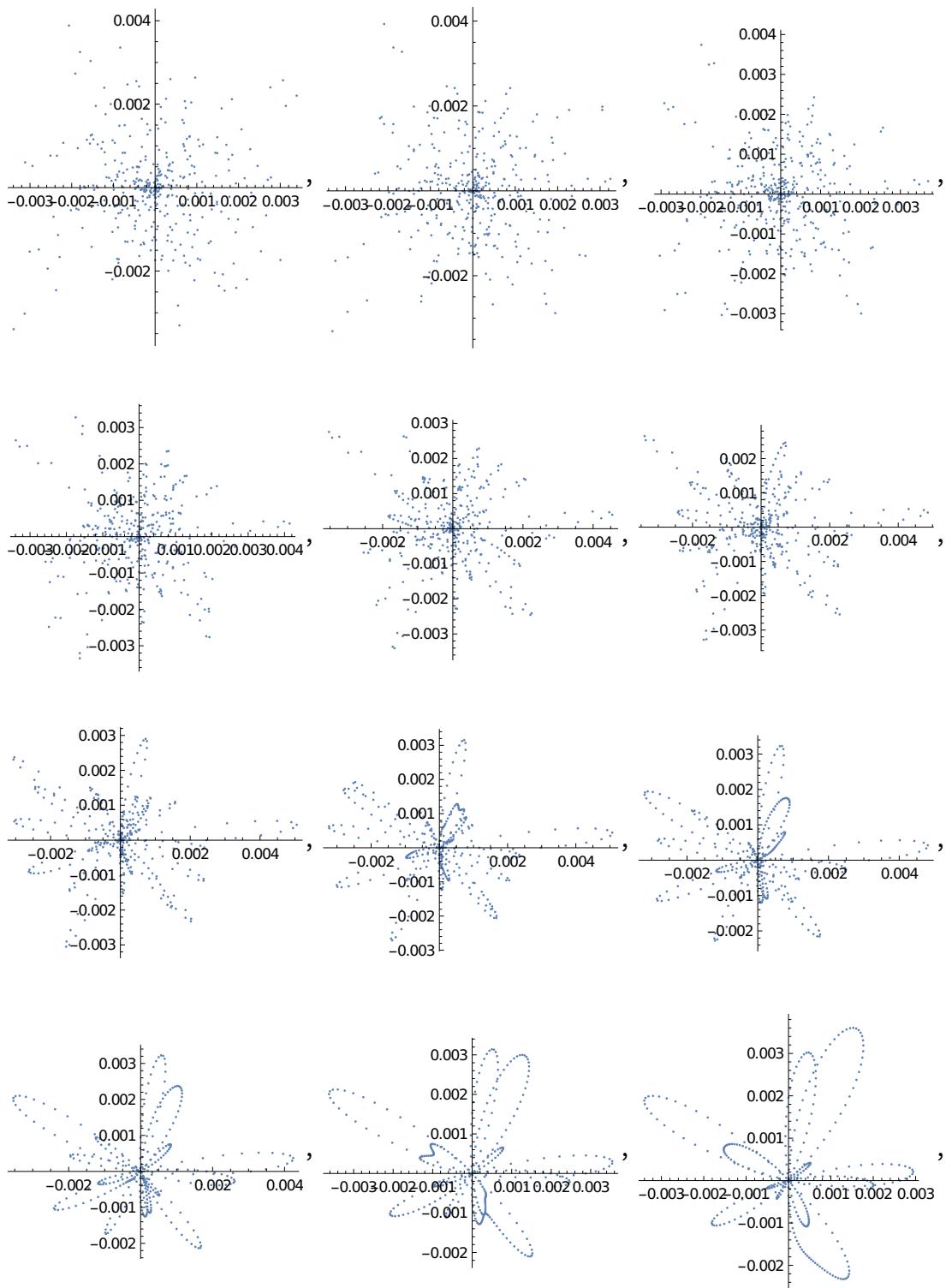
```
In[6]:= Table[ListPlot[cwd[All, "Values"][[i]], {i, Length[cwd[All, "Values"]]}]]
```

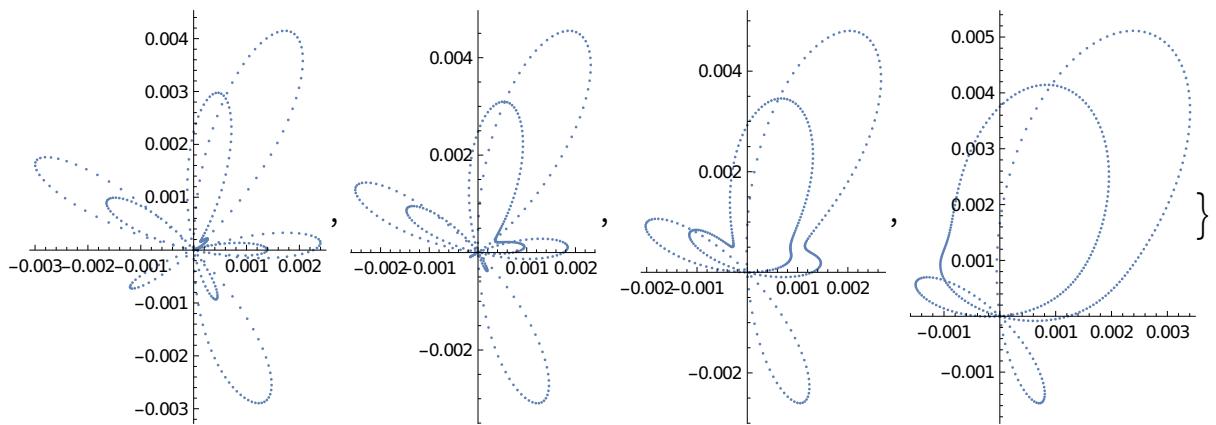




```
In[8]:= Table[ListPolarPlot[cwd[All, "Values"][[i]], {i, Length[cwd[All, "Values"]]}]]
```







(Dialog) In[]:=

$$1 - N[-1 + \text{Sqrt}[5]]$$

(Dialog) Out[=]=

$$-0.236068$$

(Dialog) In[]:=

$$-1 + N[-1 + \text{Sqrt}[5]]$$

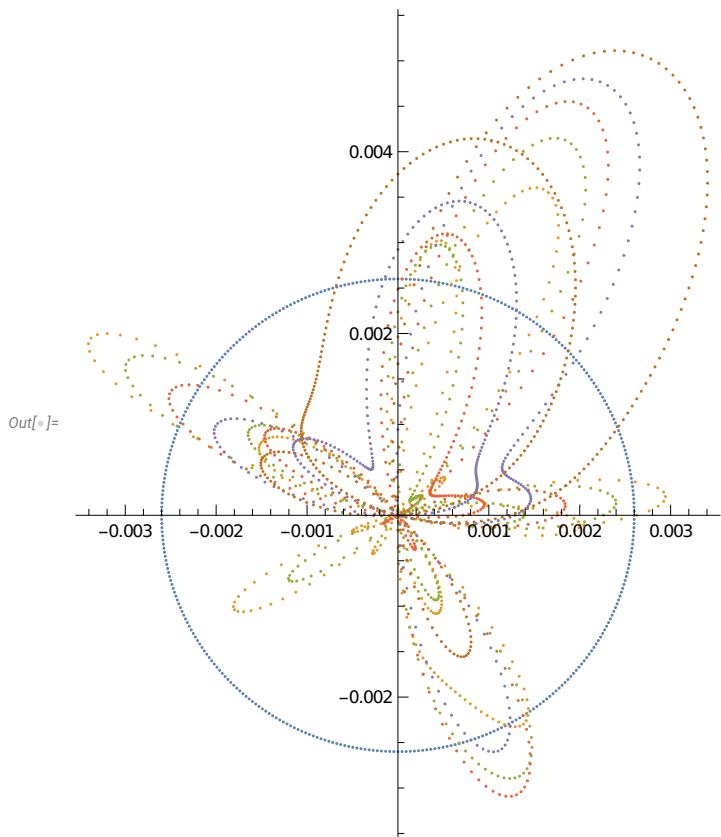
(Dialog) Out[=]=

$$0.236068$$

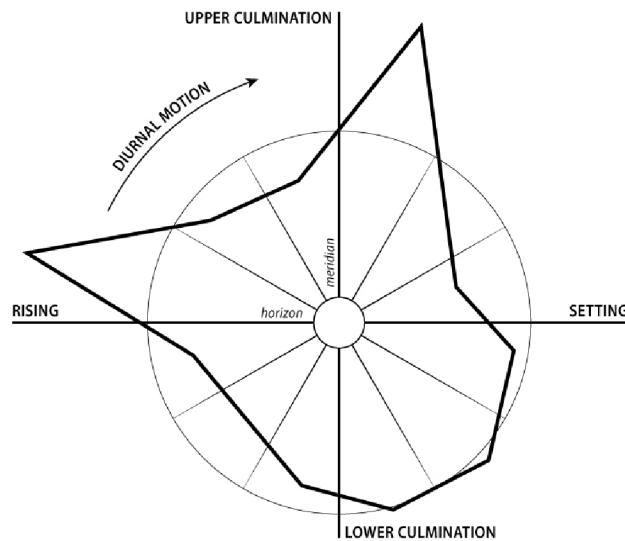
In[]:= $(1 + N[\text{Sqrt}[5]]) / 2$

Out[=]= 1.61803

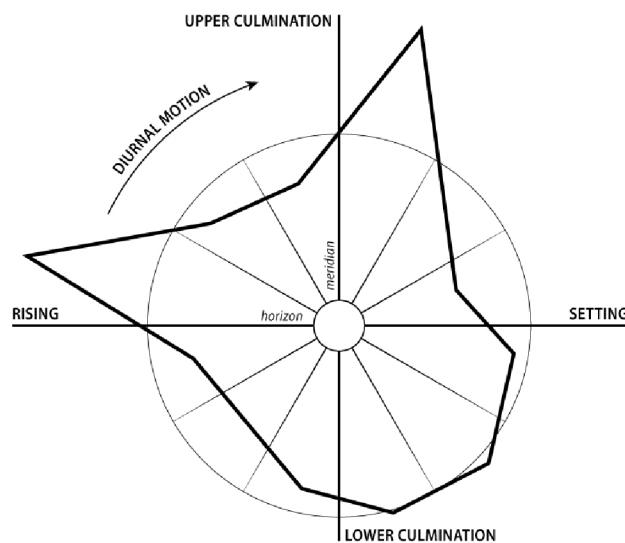
```
In[8]:= ListPolarPlot[Join[{ConstantArray[0.0052/2, 360]}, cwd[All, "Values"][[ -5 ;; -1]]]]
```



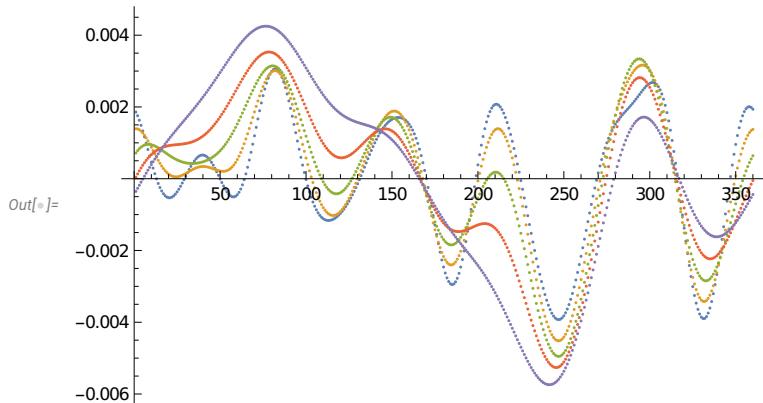
In[°]:=



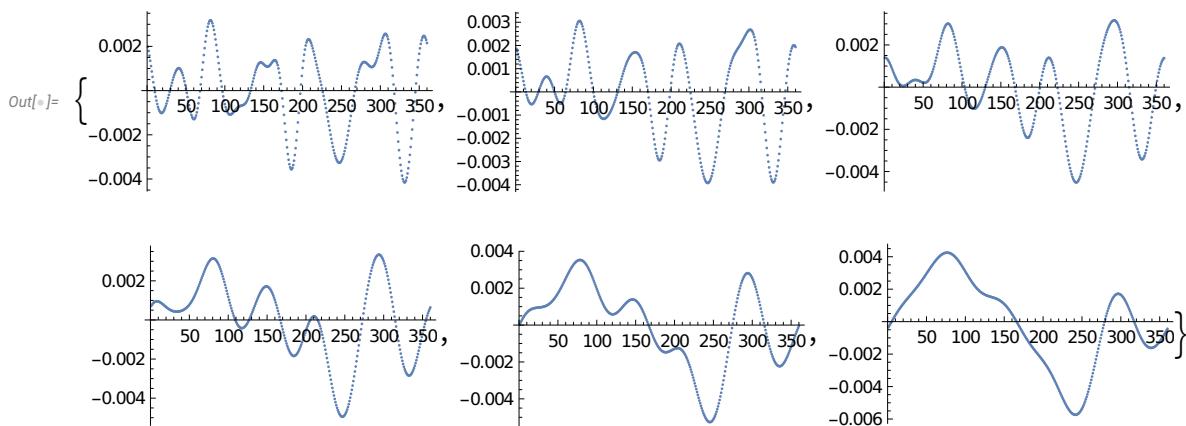
Out[°]:=



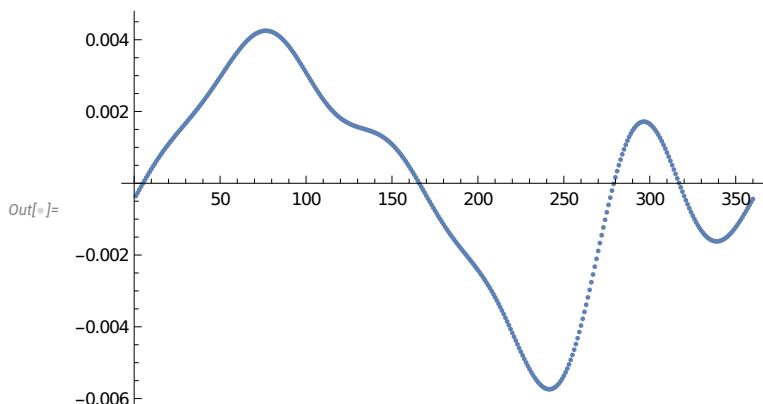
```
In[1]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]]]
```



```
In[2]:= Table[ListPlot[ContinuousWaveletTransform[data][All, "Values"][[i]], {i, -6, -1}]]
```

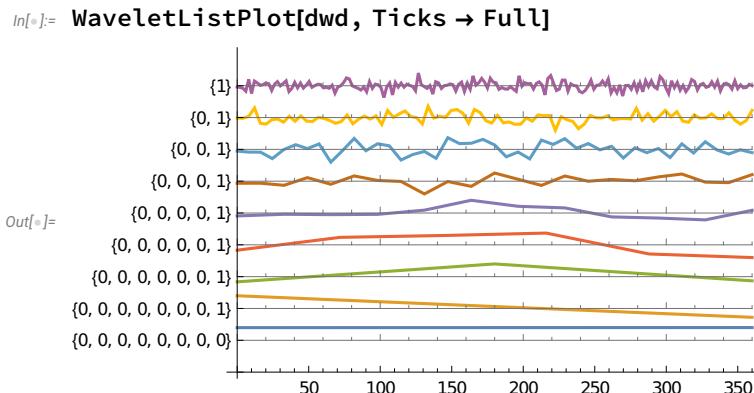


```
In[3]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -1]]]
```



```
In[4]:= dwd = DiscreteWaveletTransform[data, Automatic, 8]
```

```
Out[4]= DiscreteWaveletData[ + Data dimensions: {360}
                           Data dimensions: {360}
                           Refinements: 8 ]
```



Phi Golden Angles (Landscheidt's grand crosses, etc.)

```
In[]:= gc1 = {137.5, 47.5, 227.5, 317.5}; (*minor golden cross: 360*.382 + squares*)
In[]:= gc1 = Table[Mod[360 *.382 + i * 90, 360], {i, 0, 3}]
Out[]:= {137.52, 227.52, 317.52, 47.52}

In[]:= gc1I = Table[Mod[360 *(1 /.382) + i * 90, 360], {i, 0, 3}]
Out[]:= {222.408, 312.408, 42.4084, 132.408}

In[]:= gc2 = {68.8, 158.8, 248.8, 338.8}; (*minor golden cross: 180*.382 + squares*)
In[]:= gc2 = Table[Mod[180 *.382 + i * 90, 360], {i, 0, 3}]
Out[]:= {68.76, 158.76, 248.76, 338.76}

In[]:= gc2I = Table[Mod[180 *(1 /.382) + i * 90, 360], {i, 0, 3}]
Out[]:= {111.204, 201.204, 291.204, 21.2042}

In[]:= gc3 = {222.5, 132.5, 42.5, 312.5};(*major golden cross: 360*.618 + squares*)
In[]:= gc3I = Table[Mod[180 *(1 /.618) + i * 90, 360], {i, 0, 3}]
Out[]:= {291.262, 21.2621, 111.262, 201.262}

In[]:= gc3 = Table[Mod[360 *.618 + i * 90, 360], {i, 0, 3}]
Out[]:= {222.48, 312.48, 42.48, 132.48}

In[]:= gc4 = {111.2, 21.2, 201.2, 291.2};(*major golden cross: 180*.618 + squares*)
In[]:= gc4 = Table[Mod[180 *.618 + i * 90, 360], {i, 0, 3}]
Out[]:= {111.24, 201.24, 291.24, 21.24}

In[]:= gc4I = Table[Mod[180 *(1 /.618) + i * 90, 360], {i, 0, 3}]
Out[]:= {291.262, 21.2621, 111.262, 201.262}
```

```
In[]:= gc1a = Table[Mod[90 * .382 + i * 90, 360], {i, 0, 3}]
Out[]= {34.38, 124.38, 214.38, 304.38}

In[]:= gc1aI = Table[Mod[90 * (1 / .382) + i * 90, 360], {i, 0, 3}]
Out[=] {235.602, 325.602, 55.6021, 145.602}

In[]:= gc2a = Table[Mod[270 * .382 + i * 90, 360], {i, 0, 3}]
Out[=] {103.14, 193.14, 283.14, 13.14}

In[]:= gc2aI = Table[Mod[90 * (1 / .382) + i * 90, 360], {i, 0, 3}]
Out[=] {235.602, 325.602, 55.6021, 145.602}

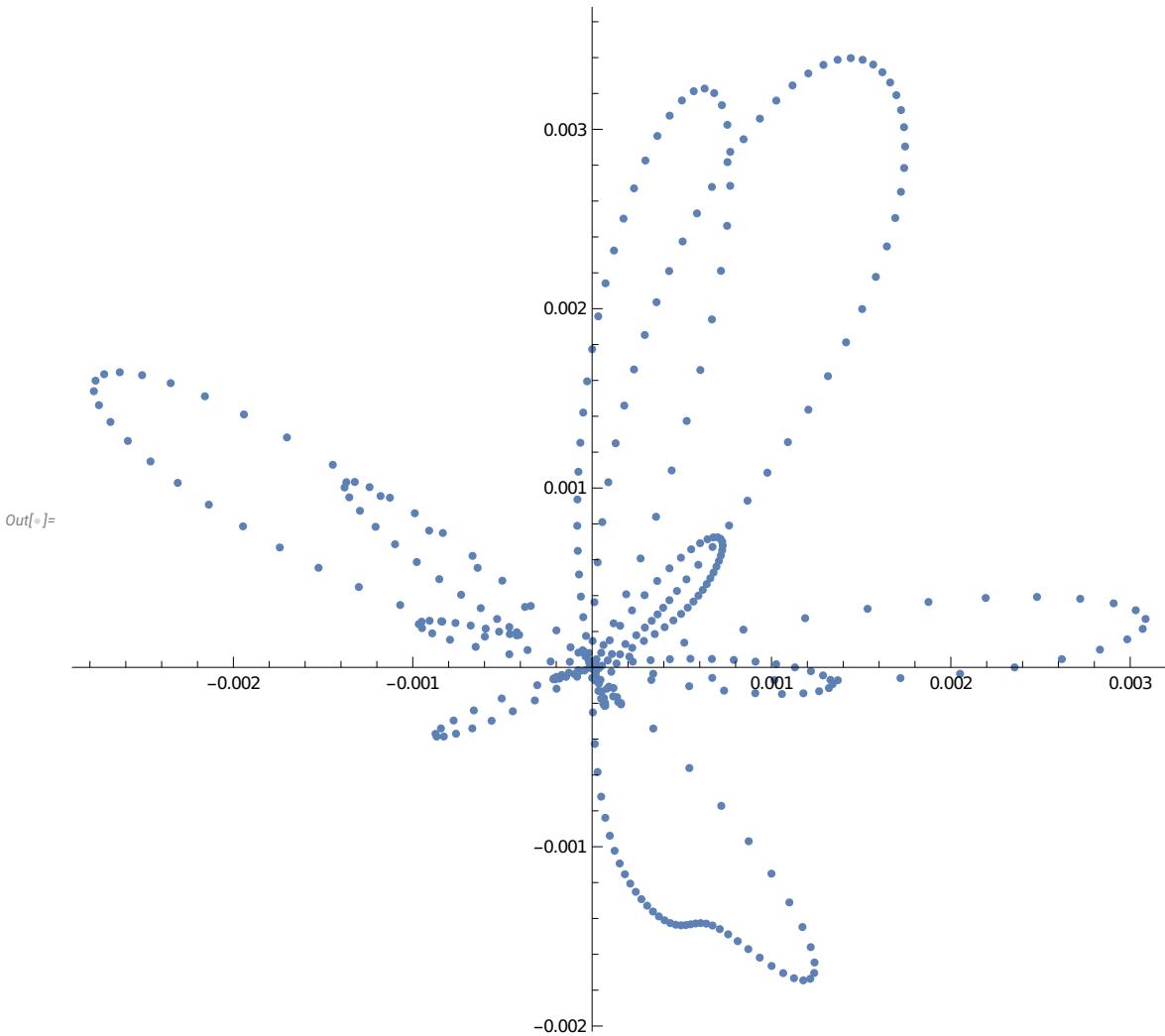
In[]:= gc3a = Table[Mod[270 * 0.618 + i * 90, 360], {i, 0, 3}]
Out[=] {166.86, 256.86, 346.86, 76.86}

In[]:= gc3aI = Table[Mod[90 * (1 / .382) + i * 90, 360], {i, 0, 3}]
Out[=] {235.602, 325.602, 55.6021, 145.602}

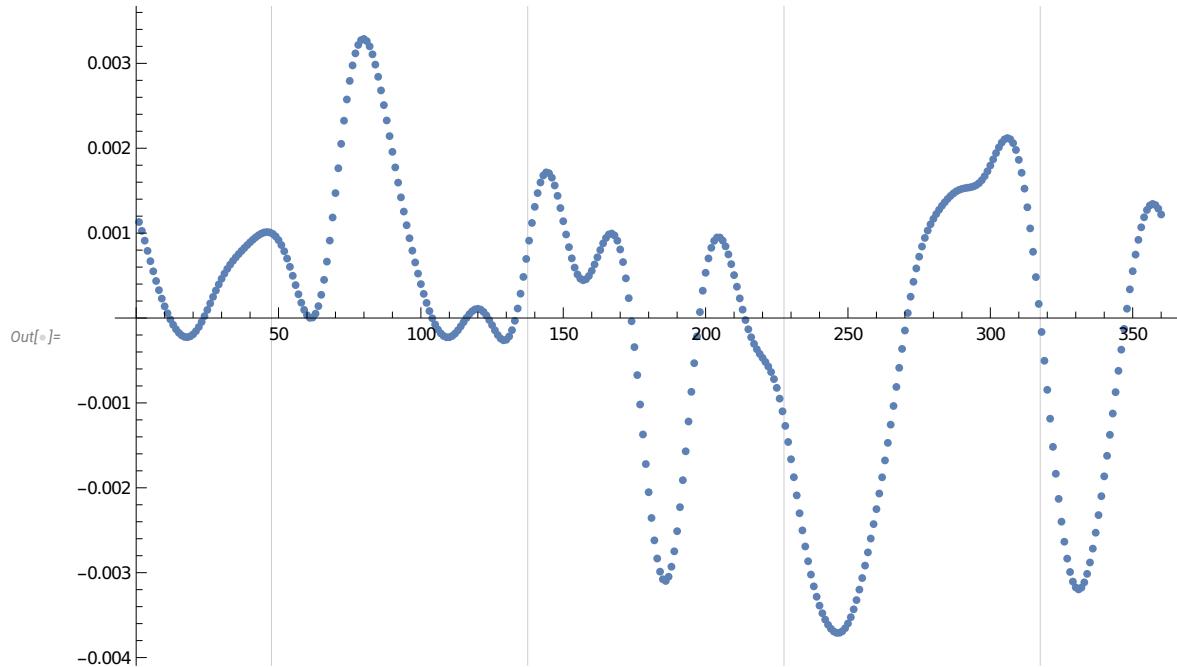
In[]:= gc4a = Table[Mod[90 * .618 + i * 90, 360], {i, 0, 3}]
Out[=] {55.62, 145.62, 235.62, 325.62}

In[]:= gc4aI = Table[Mod[90 * (1 / .382) + i * 90, 360], {i, 0, 3}]
Out[=] {235.602, 325.602, 55.6021, 145.602}
```

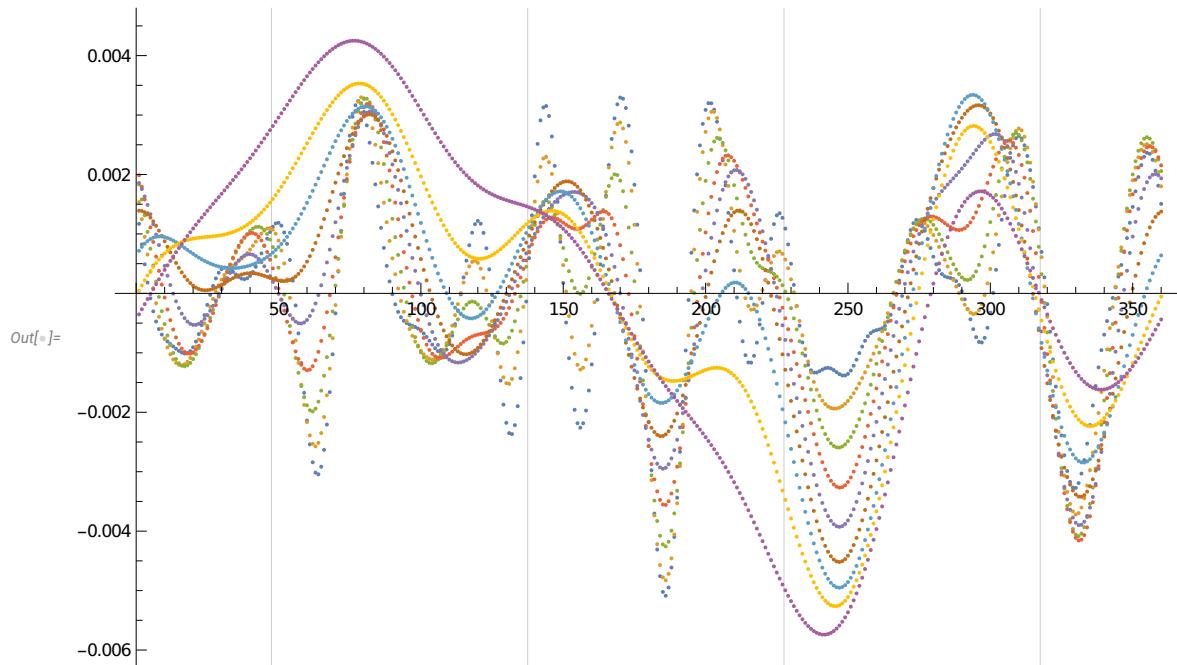
```
In[6]:= ListPolarPlot[Mean[ContinuousWaveletTransform[data][All, "Values"]][[-9 ;; -1]],  
GridLines → {gc1}, ImageSize → Large]
```



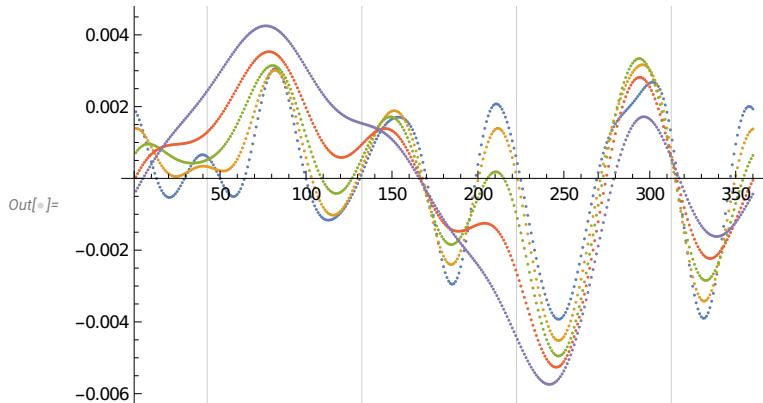
```
In[=] = ListPlot[Mean[ContinuousWaveletTransform[data][All, "Values"]][[-9 ;; -1]],
  GridLines → {gc1}, ImageSize → Large]
```



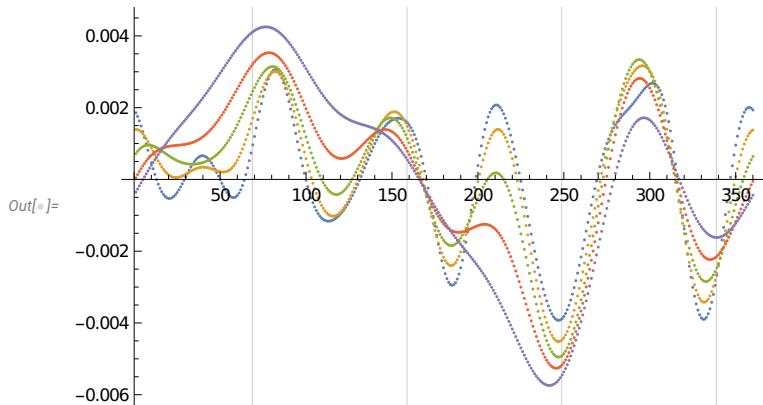
```
In[=] = ListPlot[ContinuousWaveletTransform[data][All, "Values"]][[-9 ;; -1],
  GridLines → {gc1}, ImageSize → Large] (*lines at multiple nodes!*)
```



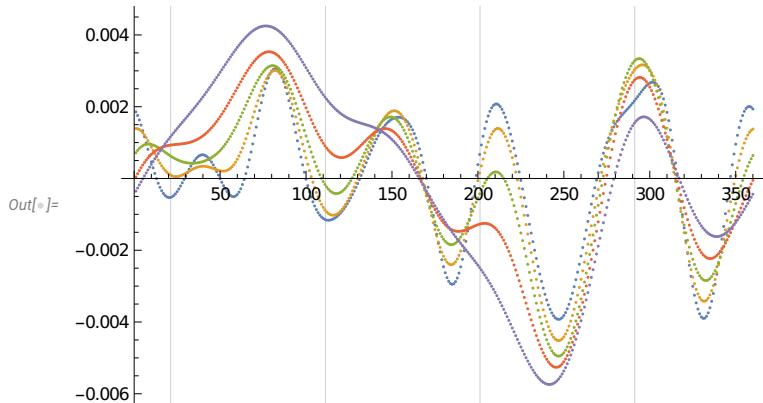
```
In[=]: ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]],
GridLines → {360 - gc1}] (*lines at multiple nodes!*)
```



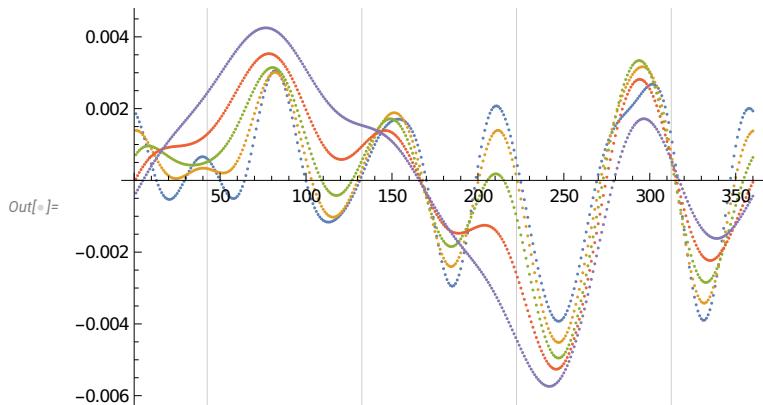
```
In[=]: ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]], GridLines → {gc2}]
(*lines at peaks and troughs*)
```



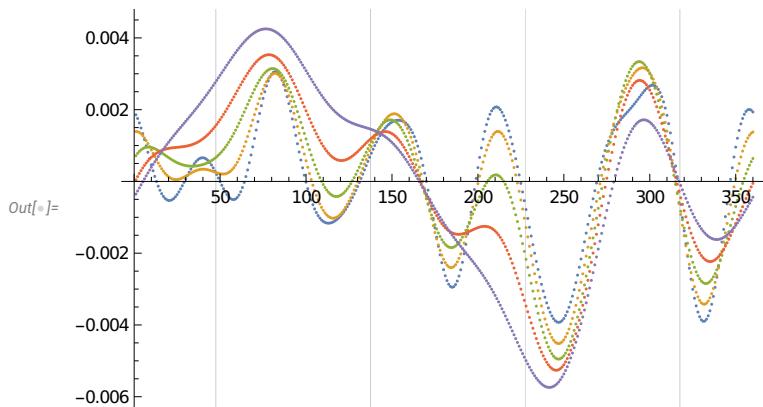
```
In[=]: ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]],
GridLines → {360 - gc2}] (*line at one node*)
```



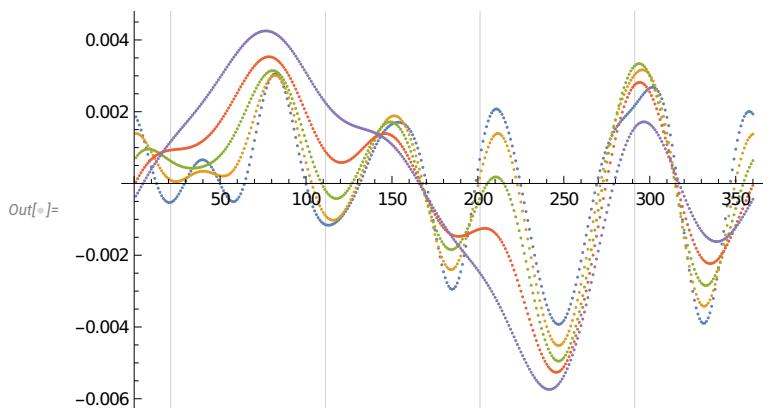
```
In[=]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]], GridLines → {gc3}]
(*line at two inner nodes*)
```



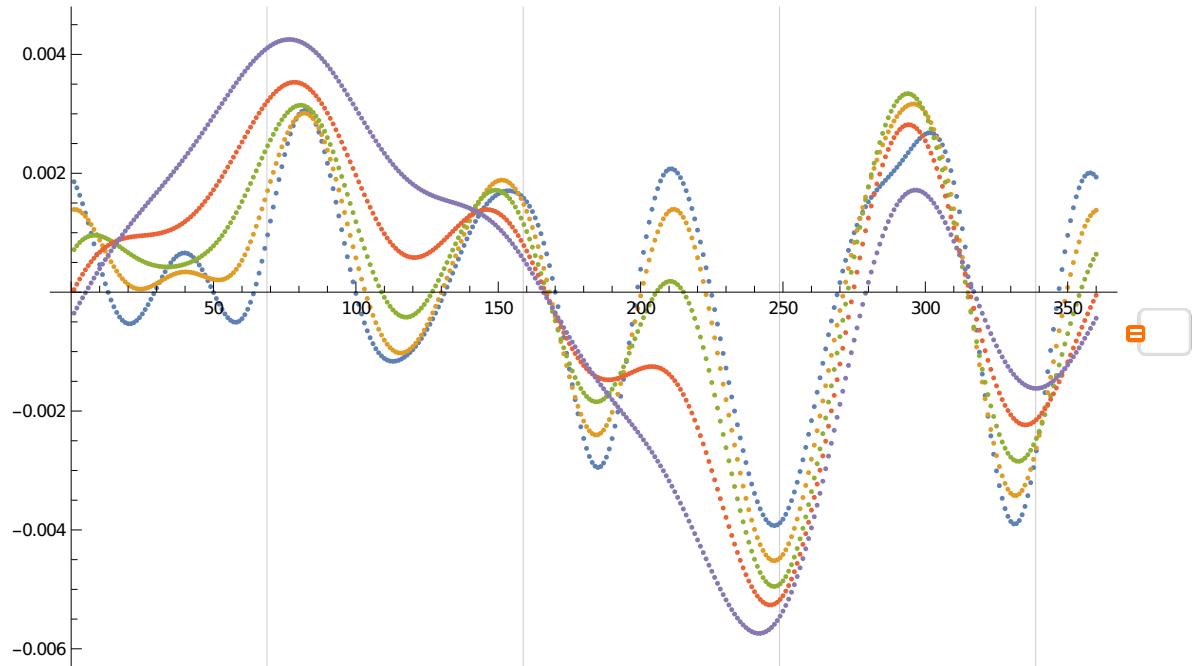
```
In[=]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]],
GridLines → {360 - gc3}](*lines at multiple nodes*)
```



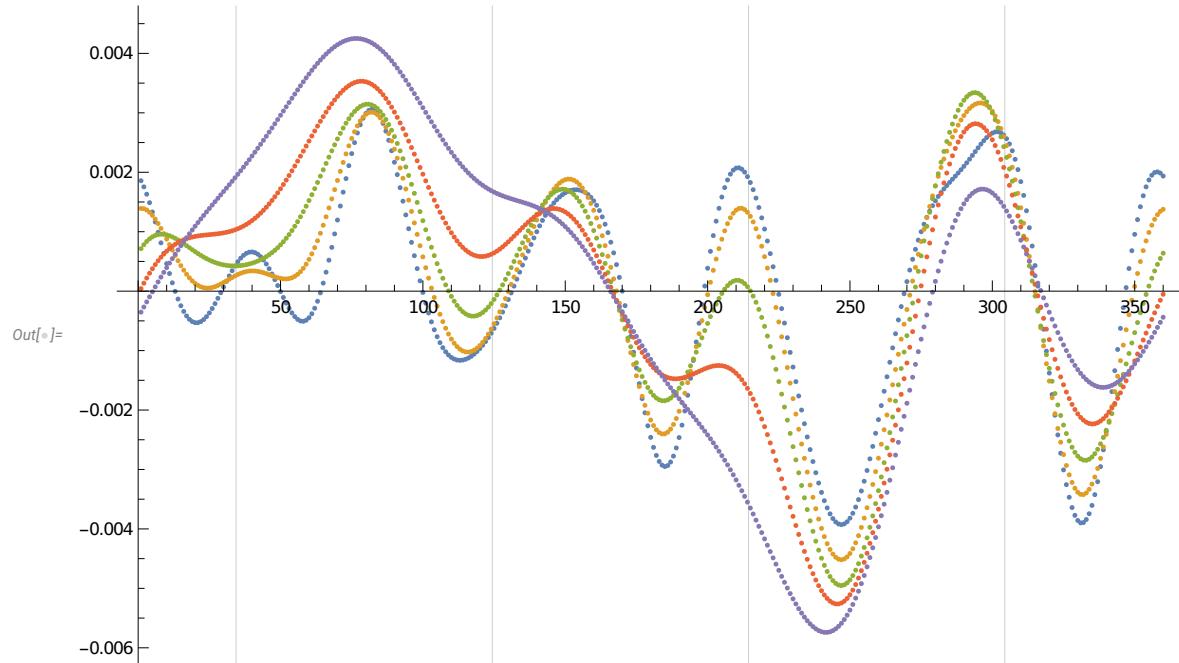
```
In[=]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]], GridLines → {gc4}]
(*line at two nodes*)
```



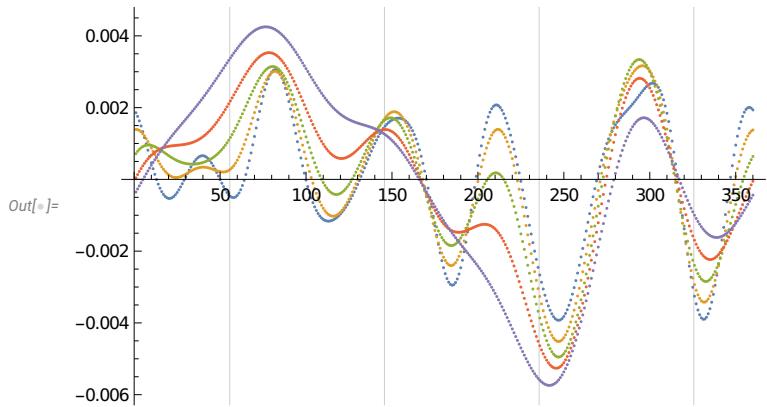
```
In[=]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1],
GridLines → {360 - gc4}, ImageSize → Large]](*lines at peaks and troughs*)
```



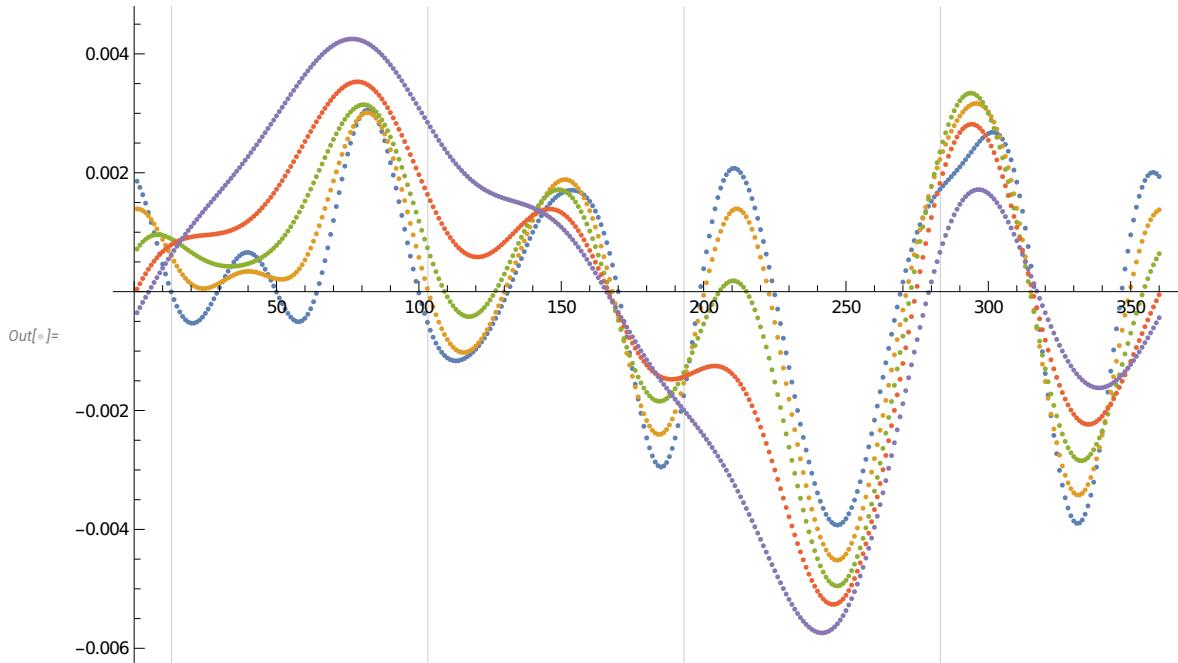
In[4]:= `ListPlot[ContinuousWaveletTransform[data][All, "Values"][[5 ;; -1]], GridLines \rightarrow {gc1a}]`



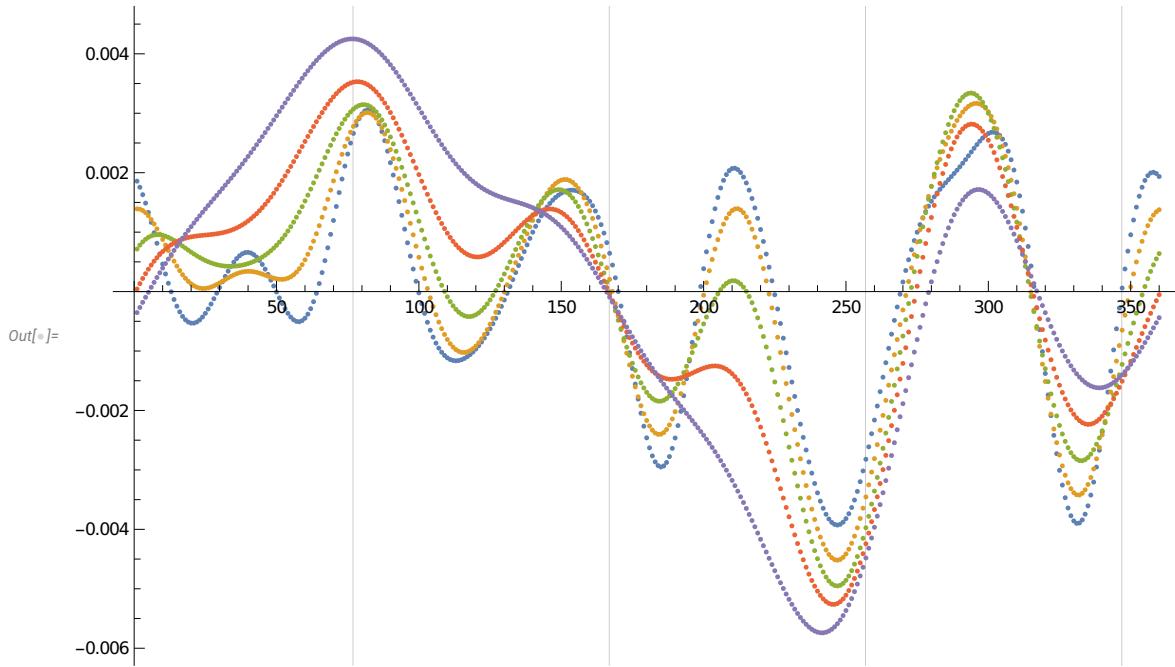
```
In[=] = ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]],
GridLines → {360 - gc1a}]
```



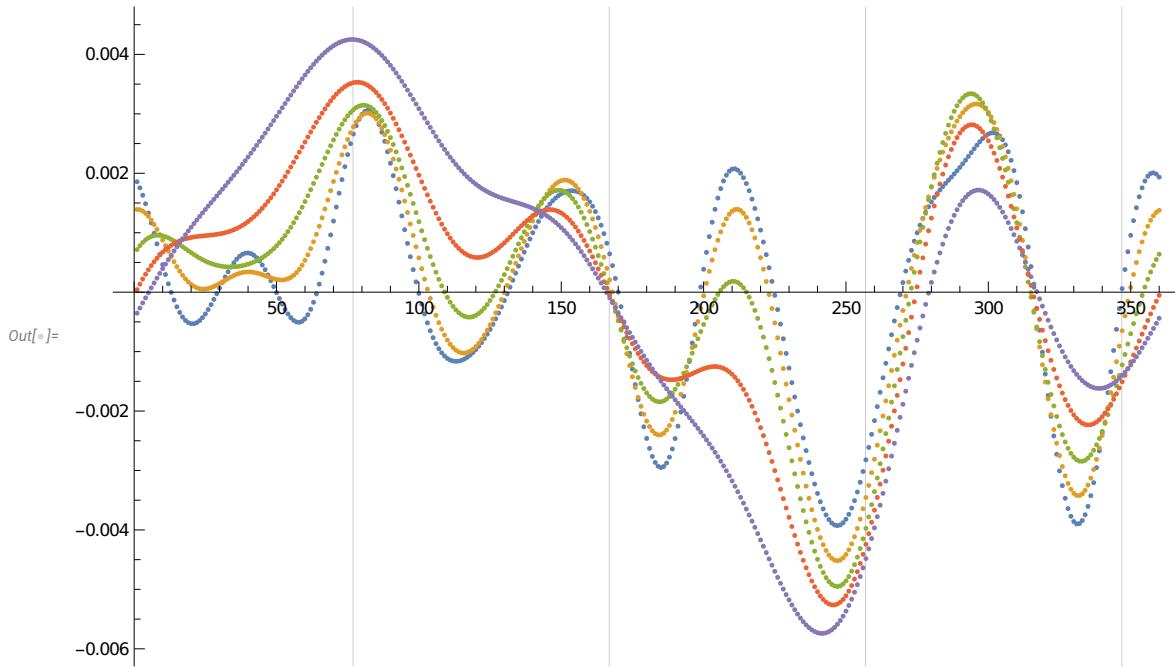
```
In[=] = ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]], GridLines → {gc2a}]
(*lines at node*)
```



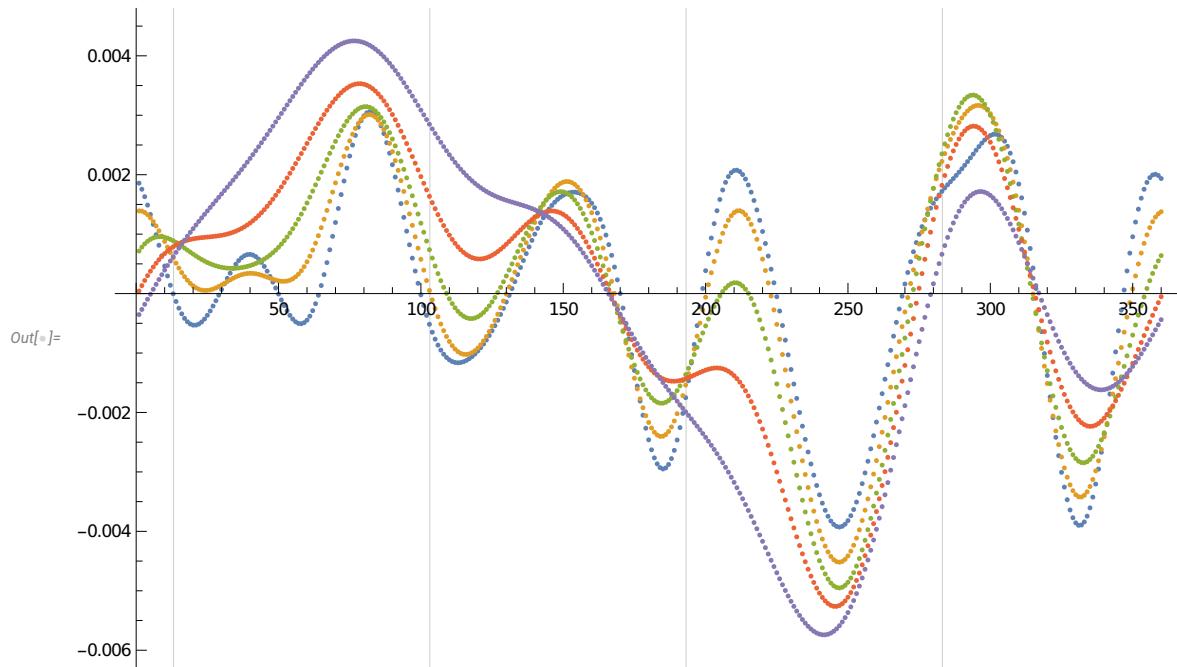
```
In[=]: ListPlot[ContinuousWaveletTransform[data][All, "Values"][[5 ;; -1]],
GridLines → {360 - gc2a}, ImageSize → Large](*lines at nodes*)
```



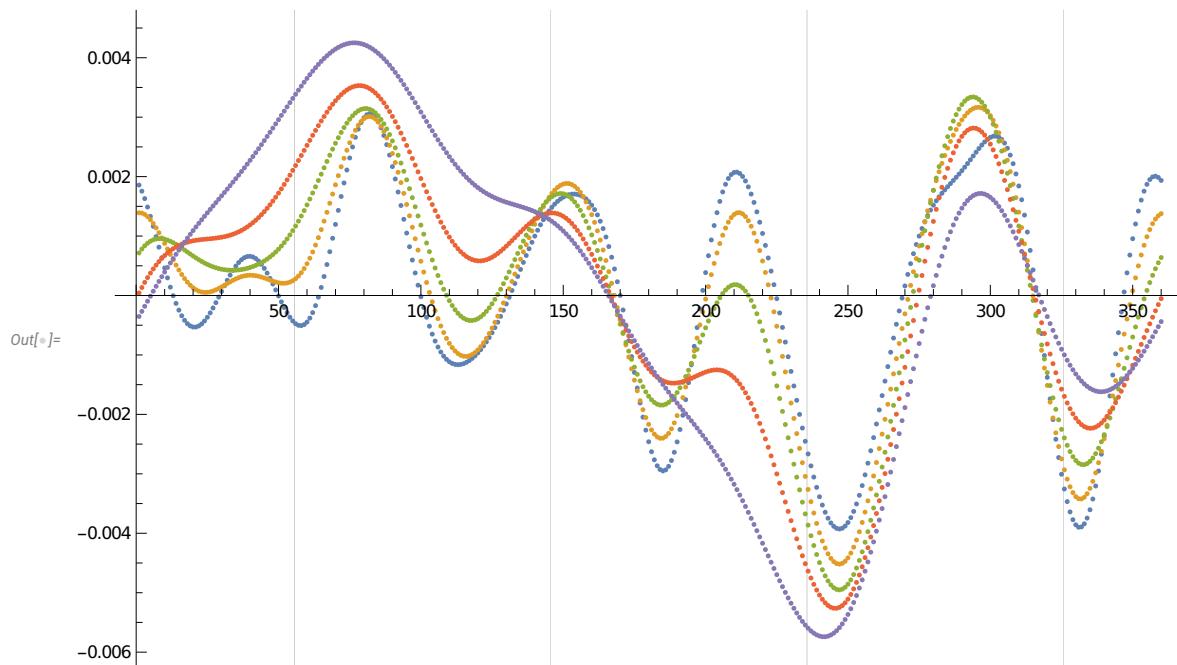
```
In[=]: ListPlot[ContinuousWaveletTransform[data][All, "Values"][[5 ;; -1]], GridLines → {gc3a}]
(*lines at one node*)
```



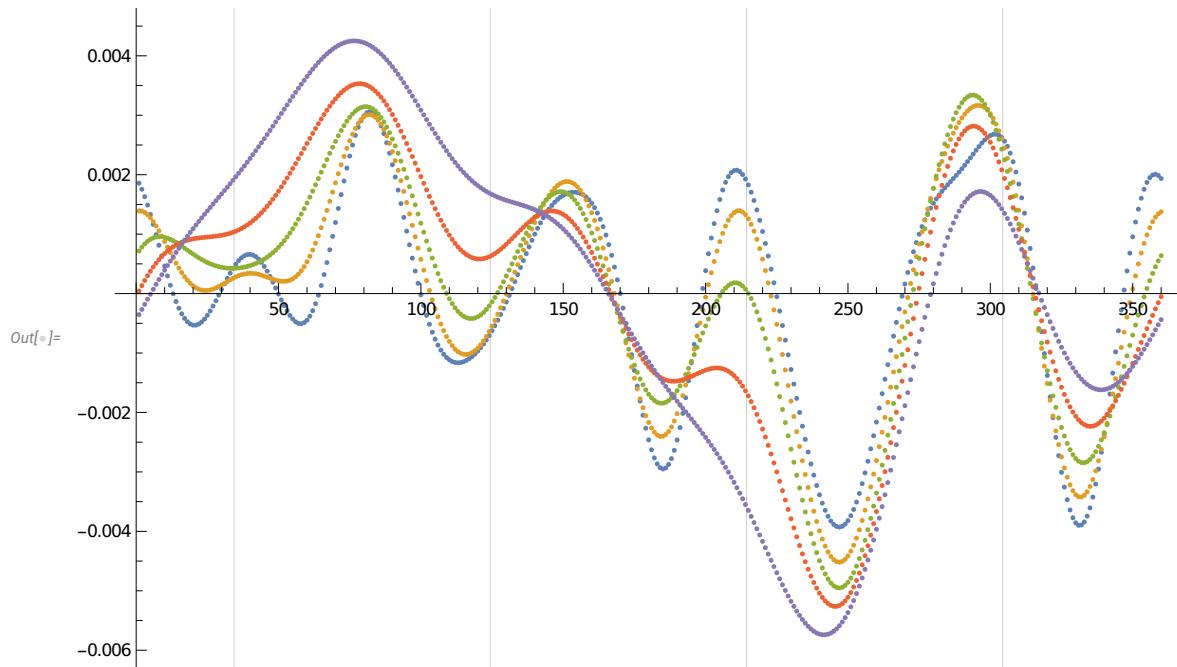
```
In[=] = ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]],
GridLines → {360 - gc3a}, ImageSize → Large]
```



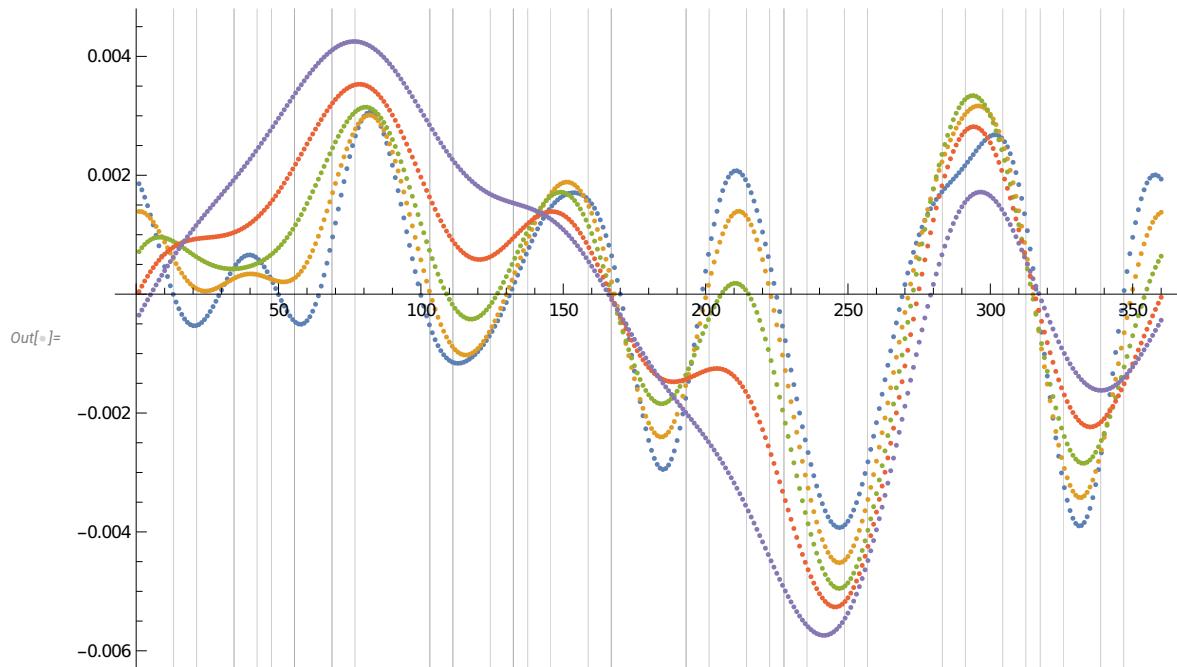
```
In[=] = ListPlot[ContinuousWaveletTransform[data][All, "Values"][[ -5 ; ; -1]], GridLines → {gc4a}]
```



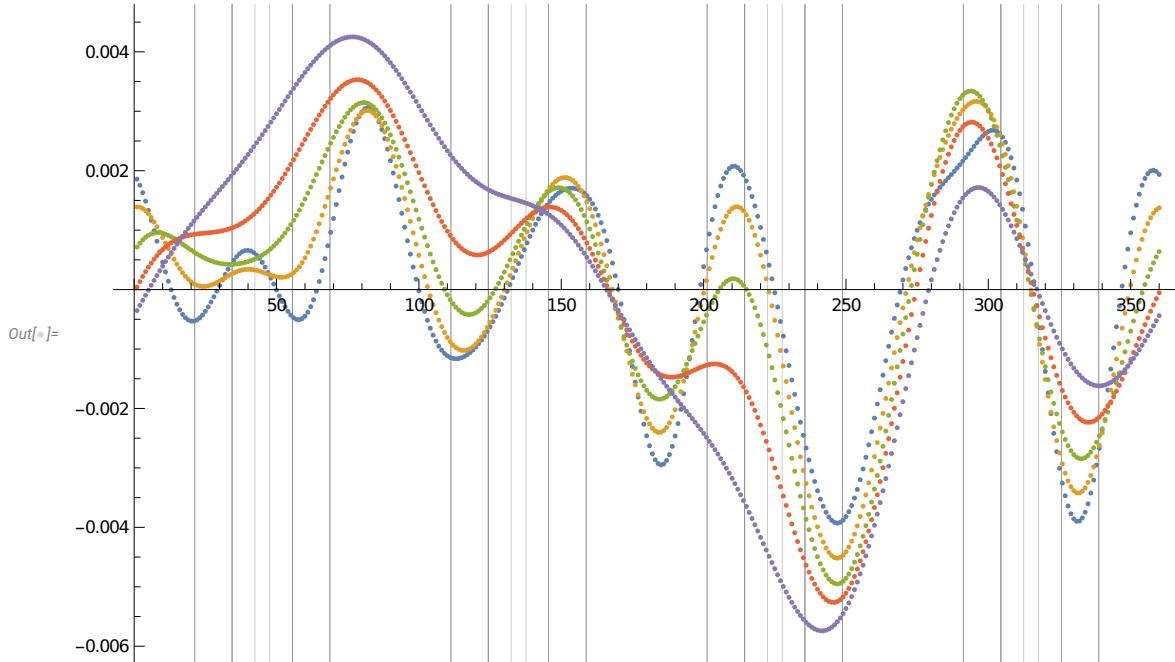
```
In[®]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[5 ;; -1]],
  GridLines → {360 - gc4a}, ImageSize → Large](*lines at peaks and troughs!*)
```



```
In[®]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[5 ;; -1]],
  GridLines → {Union[gc1, 360 - gc1, gc2, 360 - gc2, gc3, 360 - gc3, gc4, 360 - gc4, gc1a,
  360 - gc1a, gc2a, 360 - gc2a, gc3a, 360 - gc3a, gc4a, 360 - gc4a]}, ImageSize → Large]
```



```
In[1]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[5 ;; -1]],
  GridLines → {Flatten[{gc1I, 360 - gc1I, gc2I, 360 - gc2I, gc3I,
    360 - gc3I, gc4I, 360 - gc4I, gc1aI, 360 - gc1aI, gc2aI, 360 - gc2aI,
    gc3aI, 360 - gc3aI, gc4aI, 360 - gc4aI}]}, ImageSize → Large]
```



```
In[2]:= g3 = {85, 175, 264}
```

```
Out[2]= {85, 175, 264}
```

```
In[3]:= 1 - .236
```

```
Out[3]= 0.764
```

```
In[4]:= 1 /. 236
```

```
Out[4]= 4.23729
```

```
In[5]:= 1 - .236
```

```
Out[5]= 0.764
```

```
In[6]:= 1 / N[E]
```

```
Out[6]= 0.367879
```

```
In[7]:= g3 = Table[Mod[360 * (.236) + i * 90, 360], {i, 0, 3}]
```

(*special empirical angles that Lanscheidt came up with*)

```
Out[7]= {84.96, 174.96, 264.96, 354.96}
```

```
In[]:= r = Join[Table[Mod[120. + i * 90, 360], {i, 0, 3}], Table[Mod[90. + i * 90, 360], {i, 0, 3}]]  
(*my observations that we need to include squares and trines*)
```

```
Out[]= {120., 210., 300., 30., 90., 180., 270., 0.}
```

```
In[]:= Union[Flatten[{gc1, gc2, gc3, gc4, g3, r(*,g3*), 360 - g3}]]
```

```
Out[=] {0., 5.04, 21.24, 30., 42.48, 47.52, 68.76, 84.96, 90., 95.04, 111.24, 120.,  
132.48, 137.52, 158.76, 174.96, 180., 185.04, 201.24, 210., 222.48, 227.52,  
248.76, 264.96, 270., 275.04, 291.24, 300., 312.48, 317.52, 338.76, 354.96}
```

```
In[]:= Length[%]
```

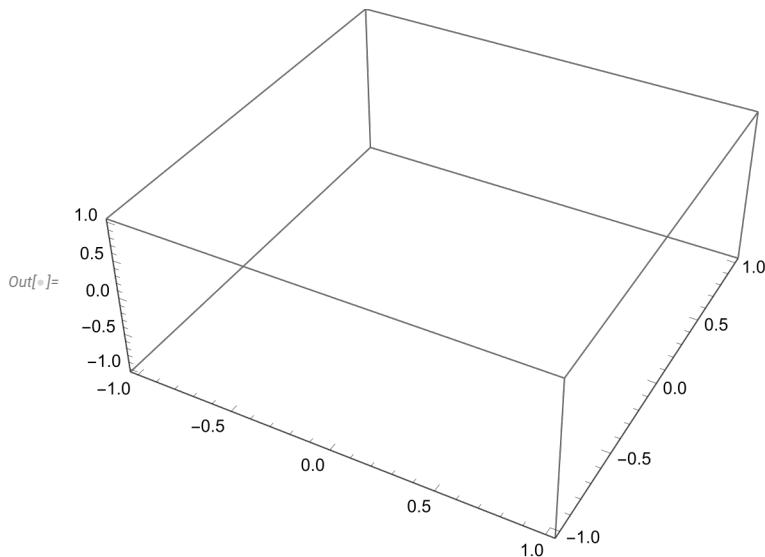
```
Out[=] 32
```

```
In[]:= fit = FindFormula[data, x, 5, All]
```

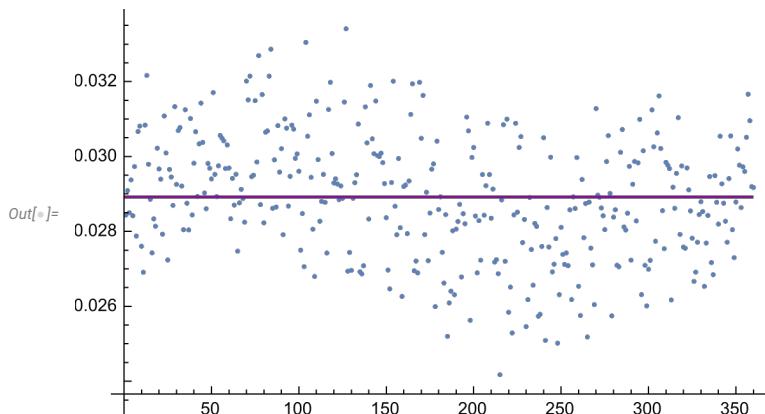
	Score	Error	Complexity
0.0289168	12.7869	0.00000268508	1
$\begin{cases} 0.0296796 - 4.24174 \times 10^{-6} x \\ 0.0944331 + 0.0000626911 x - 0.0148745 \log[x] \\ 0 \end{cases}$	12.2365	0.0000023239	18.0
-118.593 + x	-9.75426	14628.9	4
-100.54 + x	-9.91553	17189.0	4
-84.2131 + x	-10.0703	20065.6	4

```
In[]:= fit = FindFormula[data, x, 300, {"Complexity", "Error", "Score"},  
TimeConstraint → 20, PerformanceGoal → "Quality", SpecificityGoal → 1];
```

```
In[8]:= errorcomplexity = fit[[All, 2]];
errorcomplexity = Select[errorcomplexity, #[[2]] < 20 &];
ListPlot3D[errorcomplexity, Filling -> Bottom]
```

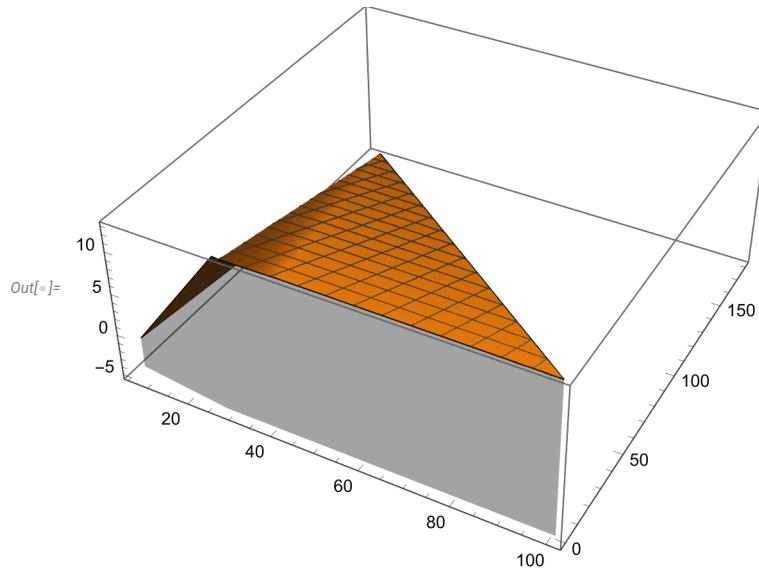


```
In[9]:= Show[ListPlot[data], Plot[fit[[1, 1]], {x, 0, 360}, ColorFunction -> "Rainbow"]]
```

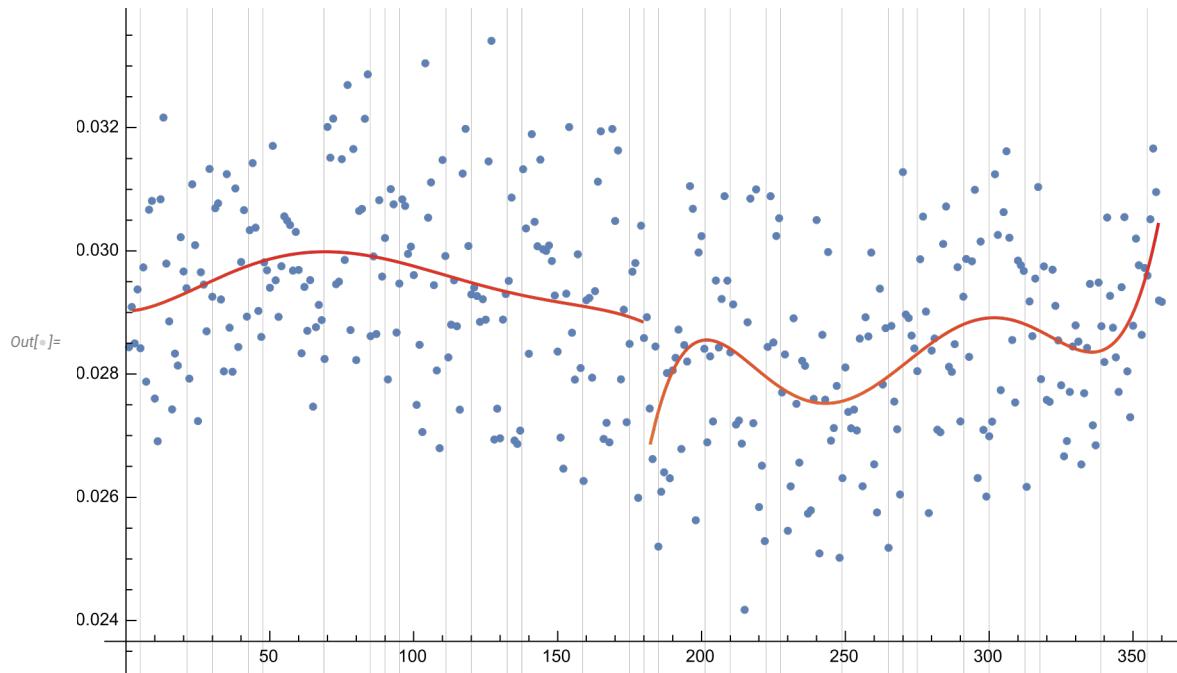


```
In[10]:= fit2 = FindFormula[data, x, 300, {"Complexity", "Error", "Score"},  
TimeConstraint -> 20, PerformanceGoal -> "Quality", SpecificityGoal -> Infinity];
```

```
In[8]:= errorcomplexity = fit2[[All, 2]];
errorcomplexity = Select[errorcomplexity, #[[2]] < 200 &];
ListPlot3D[errorcomplexity, Filling -> Bottom]
```

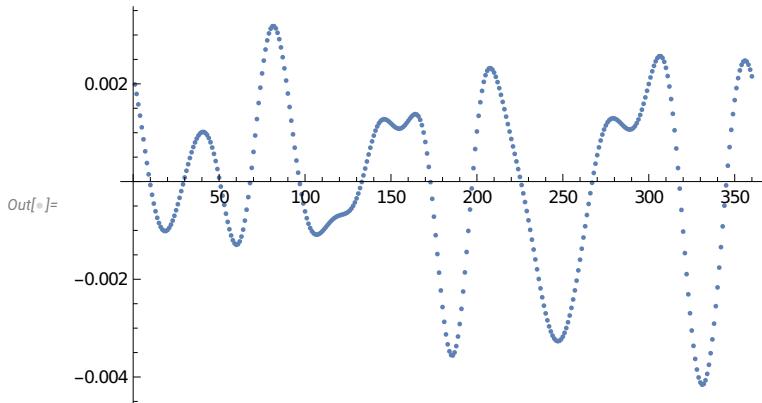


```
In[9]:= Show[ListPlot[data,
GridLines -> {Union[Flatten[{gc1, gc2, gc3, gc4, g3, r(*,g3*), 360-g3}]}],
ImageSize -> Large], Plot[fit2[[1, 1]], {x, 0, 3600}, ColorFunction -> "Rainbow"]]
```



```
In[10]:= realvalues = Re[ContinuousWaveletTransform[data][All, "Values"][[ -6 ; ; -1]]];
```

```
In[1]:= ListPlot[realvalues[[1]]]
```

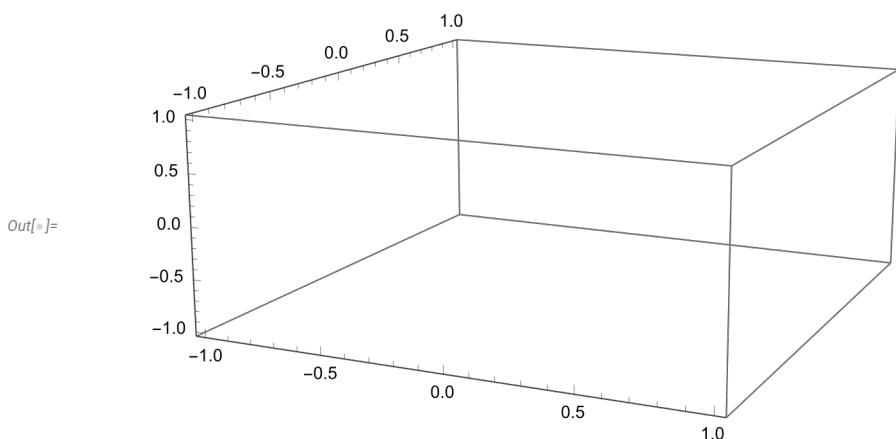


```
In[2]:= fit = FindFormula[realvalues[[1]], x, 300, {"Complexity", "Error", "Score"},  
TimeConstraint → 20, PerformanceGoal → "Quality", SpecificityGoal → 1];
```

```
In[3]:= errorcomplexity
```

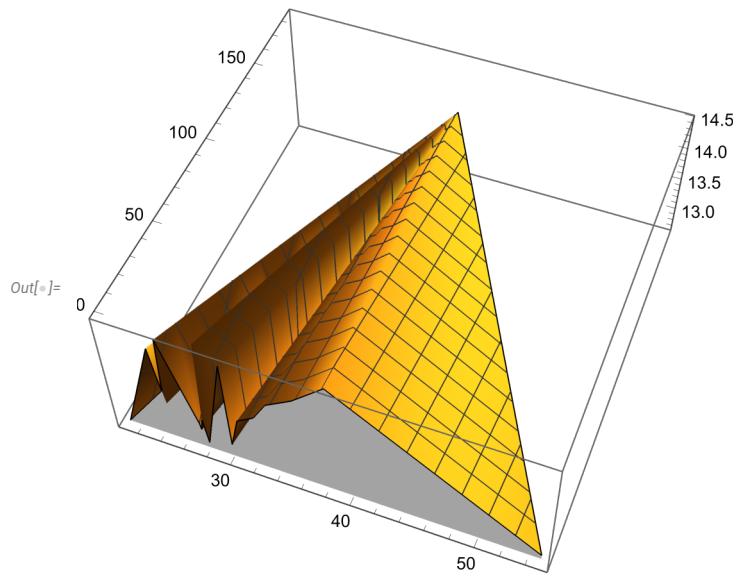
```
Out[3]= {{43., 2.0876 \times 10^{-6}, 13.0795}, {28.5, 2.15012 \times 10^{-6}, 13.05}, {101, 2.33405 \times 10^{-6}, 12.9679},  
{30, 2.38096 \times 10^{-6}, 12.948}, {6, 4.7477, -1.55766}, {8, 180.233, -5.19425}}
```

```
In[4]:= errorcomplexity = fit[[All, 2]];  
errorcomplexity = Select[errorcomplexity, #[[2]] < 50 &];  
ListPlot3D[errorcomplexity, Filling → Bottom]
```

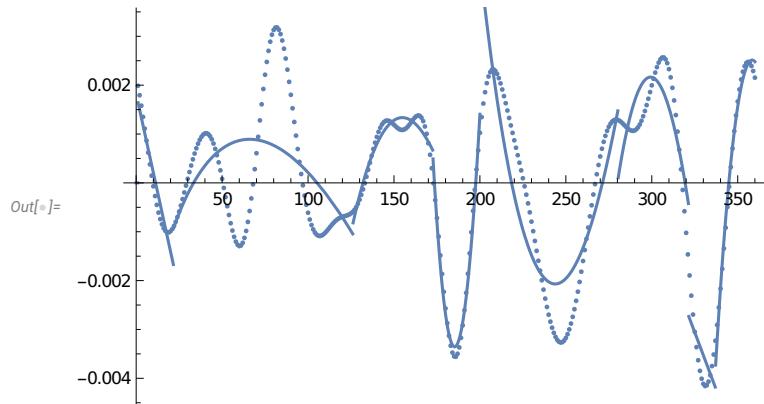


```
In[5]:= fit2 = FindFormula[realvalues[[1]], x, 300, {"Complexity", "Error", "Score"},  
TimeConstraint → 20, PerformanceGoal → "Quality", SpecificityGoal → Infinity];
```

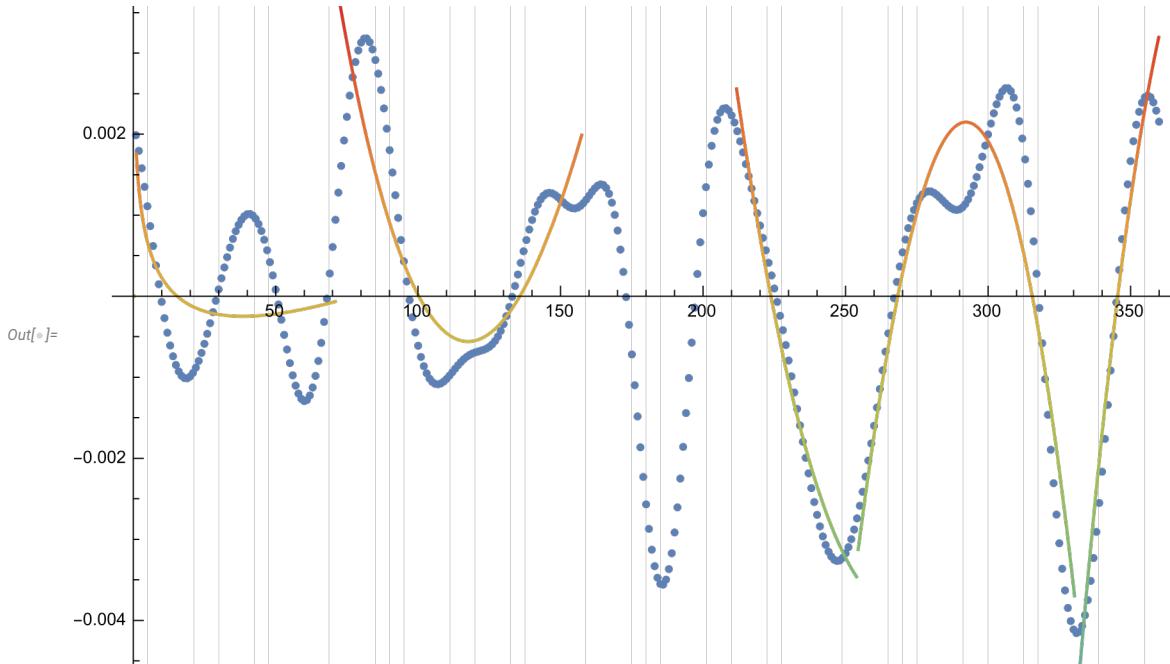
```
In[8]:= errorcomplexity = fit2[[All, 2]];
errorcomplexity = Select[errorcomplexity, #[[2]] < 200 &];
ListPlot3D[errorcomplexity, Filling -> Bottom]
```



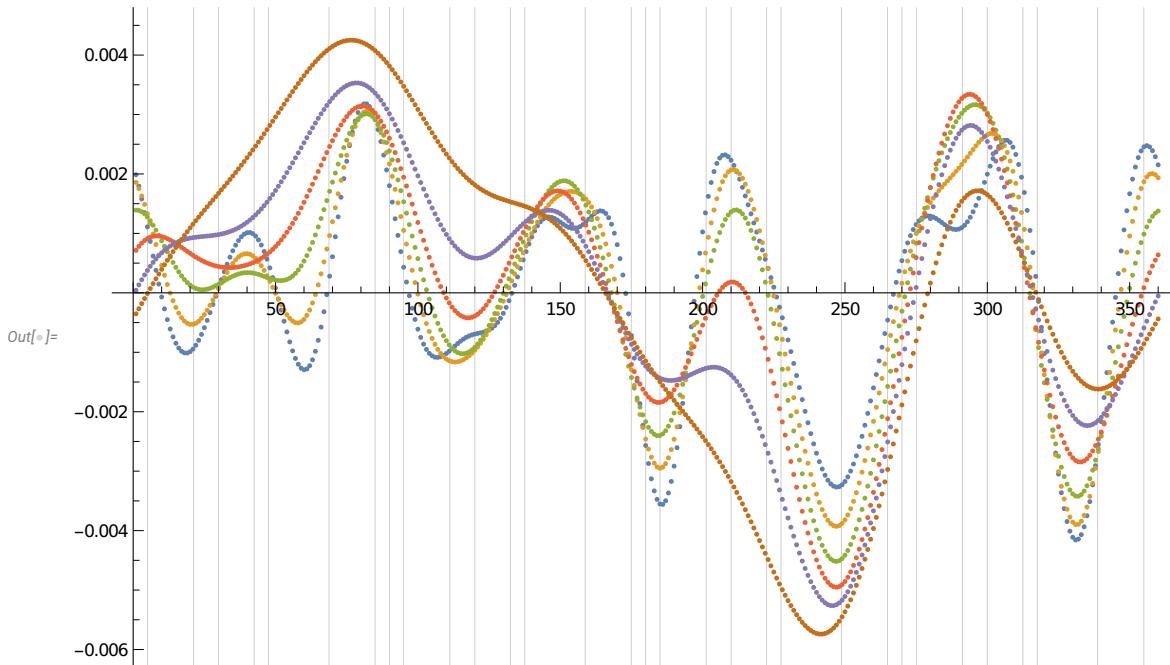
```
In[9]:= Show[ListPlot[realvalues[[1]], Plot[fit[[1, 1]], {x, 0, 360}]]
```



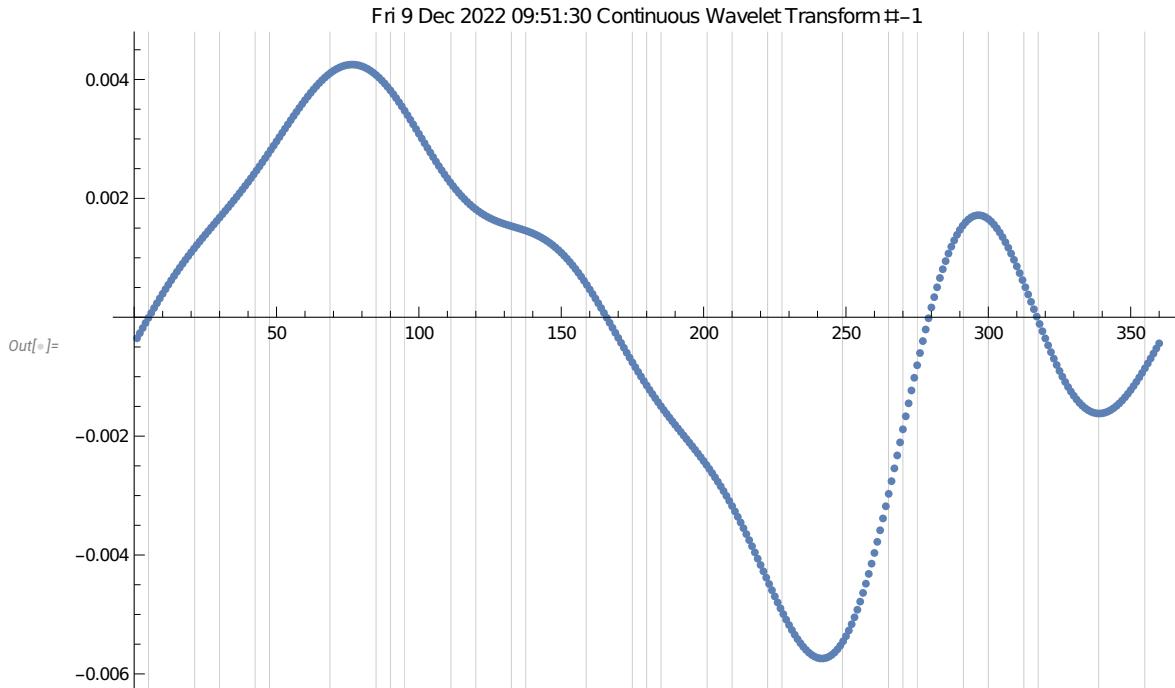
```
In[8]:= Show[ListPlot[realvalues[[1]],
  GridLines -> {Union[Flatten[{gc1, gc2, gc3, gc4, g3, r(*,g3*), 360 - g3}]]},
  ImageSize -> Large], Plot[fit2[[1, 1]], {x, 0, 360}, ColorFunction -> "Rainbow"]]
```



```
In[9]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[6 ;; -1]], GridLines ->
  {Union[Flatten[{gc1, gc2, gc3, gc4, g3, r(*,g3*), 360 - g3}]]}, ImageSize -> Large]
```



```
In[8]:= ListPlot[ContinuousWaveletTransform[data][All, "Values"][[1]], GridLines →
{Union[Flatten[{gc1, gc2, gc3, gc4, g3, r(*,g3*), 360 - g3}]]}, ImageSize → Large,
PlotLabel → DateString[Now] <> " Continuous Wavelet Transform #1" <> ToString[-1]]
```

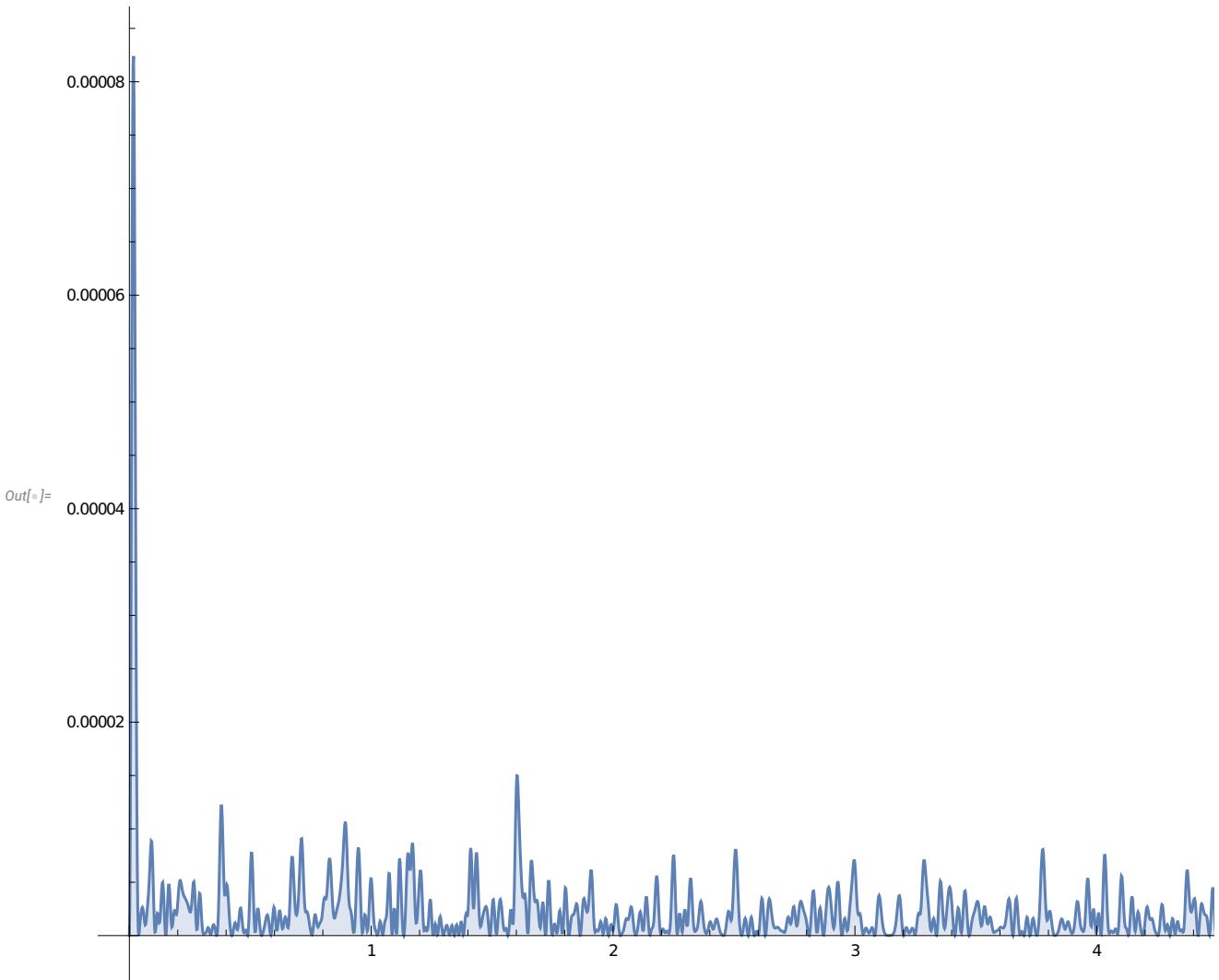


```
In[9]:= Export["movie of cwd " <> DateString[Now] <> ".mp4",
Flatten[Join[Table[ConstantArray[Rasterize[
ListPlot[ContinuousWaveletTransform[data][All, "Values"][[i]],
GridLines → {Union[Flatten[{gc1, gc2, gc3, gc4, g3, r(*,g3*), 360 - g3}]}], ImageSize → Large, PlotLabel → DateString[Now] <>
" Continuous Wavelet Transform #1" <> ToString[i]]], 30], {i, -12, -1, 1}]]]]]
```

Out[9]= movie of cwd Fri 9 Dec 2022 09:51:30.mp4

```
In[10]:= SystemOpen[%]
```

```
In[8]:= PowerSpectralDensity[data, ω];
Plot[%, {ω, 0, 2 π}, Filling → Axis, PlotRange → All]
```



```
In[9]:= t = Table[PowerSpectralDensity[data, ω], {ω, 0, Pi, 2 Pi/360}];
```

```
In[]:= FindPeaks[t, StandardDeviation[t]]
Out[]:= {{2, 0.0000822975}, {4, 2.61193 × 10-6}, {6, 7.78597 × 10-6}, {9, 4.62703 × 10-6},
{13, 5.17401 × 10-6}, {16, 4.26285 × 10-6}, {18, 2.48536 × 10-6}, {23, 0.0000110623},
{27, 1.71563 × 10-6}, {30, 7.75646 × 10-6}, {35, 1.91245 × 10-6}, {40, 4.81814 × 10-6},
{42, 8.09159 × 10-6}, {45, 1.96867 × 10-6}, {48, 5.20034 × 10-6}, {52, 0.0000102445},
{55, 7.00316 × 10-6}, {58, 4.32535 × 10-6}, {62, 2.24862 × 10-6}, {65, 7.18888 × 10-6},
{68, 8.58716 × 10-6}, {70, 6.14361 × 10-6}, {72, 2.20786 × 10-6}, {76, 8.53343 × 10-7},
{82, 7.69594 × 10-6}, {85, 2.26394 × 10-6}, {87, 2.87569 × 10-6}, {89, 3.24978 × 10-6},
{93, 0.0000145461}, {96, 5.73009 × 10-6}, {99, 3.06881 × 10-6}, {104, 2.66246 × 10-6},
{107, 2.97538 × 10-6}, {110, 4.23189 × 10-6}, {114, 1.42062 × 10-6},
{116, 1.90533 × 10-6}, {120, 2.5975 × 10-6}, {122, 2.2148 × 10-6}, {126, 5.54115 × 10-6},
{130, 7.46136 × 10-6}, {134, 5.33627 × 10-6}, {136, 2.17153 × 10-6},
{140, 1.51407 × 10-6}, {145, 6.01772 × 10-6}, {147, 1.55704 × 10-6}, {151, 3.3028 × 10-6},
{153, 2.61723 × 10-6}, {158, 1.80106 × 10-6}, {160, 3.18822 × 10-6}, {163, 4.18753 × 10-6},
{167, 3.87643 × 10-6}, {169, 4.738 × 10-6}, {173, 6.09833 × 10-6}, {179, 2.7793 × 10-6}}

In[]:= FindFormula[Flatten[Position[PeakDetect[t], 1]], x]
Out[]:= 4.90561 x

In[]:= FindSequenceFunction[Flatten[Position[PeakDetect[t], 1]], x]
Out[]:= FindSequenceFunction[
{2, 6, 9, 13, 23, 30, 35, 42, 48, 52, 55, 58, 65, 68, 76, 82, 87, 89, 93, 104, 107,
110, 116, 120, 122, 126, 130, 134, 140, 145, 151, 160, 163, 167, 169, 173, 179}, x]
```

$ln[~]:= \mathbf{t}$

```
Out[~]= {4.23516 × 10-21, 0.0000822975, 2.20374 × 10-6, 2.61193 × 10-6, 1.40262 × 10-6, 7.78597 × 10-6,  

6.0857 × 10-7, 1.30944 × 10-6, 4.62703 × 10-6, 2.53196 × 10-6, 9.24221 × 10-7, 2.01016 × 10-6,  

5.17401 × 10-6, 3.65847 × 10-6, 2.69906 × 10-6, 4.26285 × 10-6, 5.24171 × 10-7,  

2.48536 × 10-6, 2.2301 × 10-7, 3.74681 × 10-7, 1.02107 × 10-6, 1.17549 × 10-6, 0.0000110623,  

4.62831 × 10-6, 4.05884 × 10-7, 1.18731 × 10-6, 1.71563 × 10-6, 4.17798 × 10-7,  

2.76913 × 10-9, 7.75646 × 10-6, 8.36615 × 10-7, 5.74536 × 10-7, 8.48953 × 10-7,  

1.42494 × 10-6, 1.91245 × 10-6, 4.5841 × 10-7, 1.26978 × 10-6, 1.74831 × 10-6,  

2.90608 × 10-6, 4.81814 × 10-6, 3.08976 × 10-6, 8.09159 × 10-6, 2.24882 × 10-6,  

3.1081 × 10-7, 1.96867 × 10-6, 1.0744 × 10-6, 3.14046 × 10-6, 5.20034 × 10-6, 4.03883 × 10-6,  

2.17659 × 10-6, 4.33545 × 10-6, 0.0000102445, 3.36767 × 10-6, 4.99553 × 10-7,  

7.00316 × 10-6, 1.12564 × 10-6, 1.64276 × 10-6, 4.32535 × 10-6, 1.05805 × 10-6,  

3.69245 × 10-7, 7.73542 × 10-8, 2.24862 × 10-6, 1.69864 × 10-6, 1.60259 × 10-6,  

7.18888 × 10-6, 1.92016 × 10-8, 7.75831 × 10-6, 8.58716 × 10-6, 1.14096 × 10-6,  

6.14361 × 10-6, 5.2366 × 10-7, 2.20786 × 10-6, 9.70552 × 10-9, 3.45343 × 10-8,  

8.37776 × 10-7, 8.53343 × 10-7, 2.26274 × 10-7, 2.14606 × 10-8, 7.43427 × 10-8,  

2.50666 × 10-7, 1.84269 × 10-6, 7.69594 × 10-6, 6.51951 × 10-6, 1.24228 × 10-6,  

2.26394 × 10-6, 1.41111 × 10-6, 2.87569 × 10-6, 1.83813 × 10-7, 3.24978 × 10-6,  

5.74474 × 10-7, 8.93649 × 10-7, 1.53543 × 10-6, 0.0000145461, 4.47213 × 10-6,  

2.47896 × 10-6, 5.73009 × 10-6, 3.37197 × 10-6, 1.78981 × 10-6, 3.06881 × 10-6,  

2.91714 × 10-6, 4.82099 × 10-7, 6.55705 × 10-7, 2.3234 × 10-6, 2.66246 × 10-6, 2.72281 × 10-7,  

1.9232 × 10-6, 2.97538 × 10-6, 4.27004 × 10-7, 2.96195 × 10-6, 4.23189 × 10-6, 1.75275 × 10-6,  

4.31899 × 10-7, 6.41211 × 10-7, 1.42062 × 10-6, 9.82214 × 10-7, 1.90533 × 10-6,  

5.22581 × 10-7, 4.20071 × 10-7, 1.53308 × 10-6, 2.5975 × 10-6, 8.30099 × 10-8, 2.2148 × 10-6,  

1.37359 × 10-6, 9.56749 × 10-7, 7.80102 × 10-7, 5.54115 × 10-6, 2.29628 × 10-7,  

2.72224 × 10-7, 3.90583 × 10-7, 7.46136 × 10-6, 6.76477 × 10-7, 3.4823 × 10-7, 1.13114 × 10-6,  

5.33627 × 10-6, 3.78032 × 10-7, 2.17153 × 10-6, 1.31954 × 10-6, 4.24561 × 10-7,  

9.11629 × 10-7, 1.51407 × 10-6, 3.11579 × 10-7, 1.04137 × 10-7, 2.27622 × 10-6,  

3.46485 × 10-6, 6.01772 × 10-6, 3.48451 × 10-8, 1.55704 × 10-6, 9.40194 × 10-7,  

4.40607 × 10-8, 9.74431 × 10-8, 3.3028 × 10-6, 1.00097 × 10-6, 2.61723 × 10-6, 6.94871 × 10-7,  

6.16022 × 10-7, 3.16262 × 10-7, 1.69067 × 10-6, 1.80106 × 10-6, 1.02754 × 10-6,  

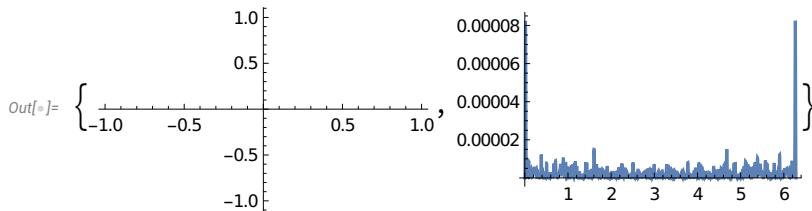
3.18822 × 10-6, 2.00392 × 10-6, 1.18872 × 10-8, 4.18753 × 10-6, 3.26441 × 10-7,  

1.44135 × 10-6, 2.10494 × 10-6, 3.87643 × 10-6, 8.04225 × 10-7, 4.738 × 10-6, 3.65422 × 10-7,  

4.95963 × 10-7, 4.14106 × 10-6, 6.09833 × 10-6, 2.09338 × 10-6, 1.93174 × 10-7,  

3.35603 × 10-7, 7.39172 × 10-7, 1.28651 × 10-6, 2.7793 × 10-6, 1.81209 × 10-7, 7.36355 × 10-9}
```

```
In[1]:= Plot[#, {ω, 0, 2π}, Filling → Axis, PlotRange → All] & /@  
{PowerSpectralDensity[proc, ω], PowerSpectralDensity[data, ω]}
```



```
In[2]:= Length[Union[Flatten[{gc1, gc2, gc3, gc4, g3, r}]]]
```

```
Out[2]= 28
```

```
In[3]:= Length[Union[gc1, gc2, 360-gc2, gc3, 360-gc3, gc4, 360-gc4,  
gc1a, 360-gc1a, gc2a, 360-gc2a, gc3a, 360-gc3a, gc4a, 360-gc4a]]
```

```
Out[3]= 40
```

Monte Carlo Simulation to get a sense of the p-value of such successful intersections

```
In[4]:= (*SimulationResults={};  
simulatedgraphpoints=Table[RandomReal[{0,360},33],{i,10000000}];  
orb=5;  
For[i=1,i≤1000000,i++,  
randomvaluesforangles=RandomReal[{0,1},2];  
simulatedangles=  
Union[Join[Table[Mod[360*(1-randomvaluesforangles[[1]])+i*90,360],{i,0,3}],  
Table[Mod[180*(1-randomvaluesforangles[[1]])+i*90,360],{i,0,3}],  
Join[Table[Mod[360*(randomvaluesforangles[[1]])+i*90,360],{i,0,3}],  
Table[Mod[180*(randomvaluesforangles[[1]])+i*90,360],{i,0,3}],  
Table[Mod[360*(randomvaluesforangles[[2]])+i*90,360],{i,0,3}],  
360-Table[Mod[360*(randomvaluesforangles[[2]])+i*90,360],{i,0,3}],r]];  
count=0;  
For[k=1,k≤33,k++,  
count1=0;  
For[j=1,j≤Length[simulatedangles],j++,  
If[Mod[Abs[simulatedgraphpoints[[i,k]]-simulatedangles[[j]]],360]≤orb||  
360-Mod[Abs[simulatedgraphpoints[[i,k]]-simulatedangles[[j]]],360]≤orb, count1=1];  
count=count+count1;  
];  
AppendTo[SimulationResults,count];  
];*)
```

In[5]:= (*i*)

```

In[]:= (*Dimensions[simulatedgraphpoints]*)

In[]:= (*Length[simulatedangles]*)

In[]:= (*Histogram[SimulationResults]*)

In[]:= (*Count[SimulationResults,u_-;u≥30]*)

In[]:= (*phat=N[13268/1000001]*)

In[]:= (*Count[SimulationResults,u_-;u≥32]*)

In[]:= (*Count[SimulationResults,u_-;u≥33]*)

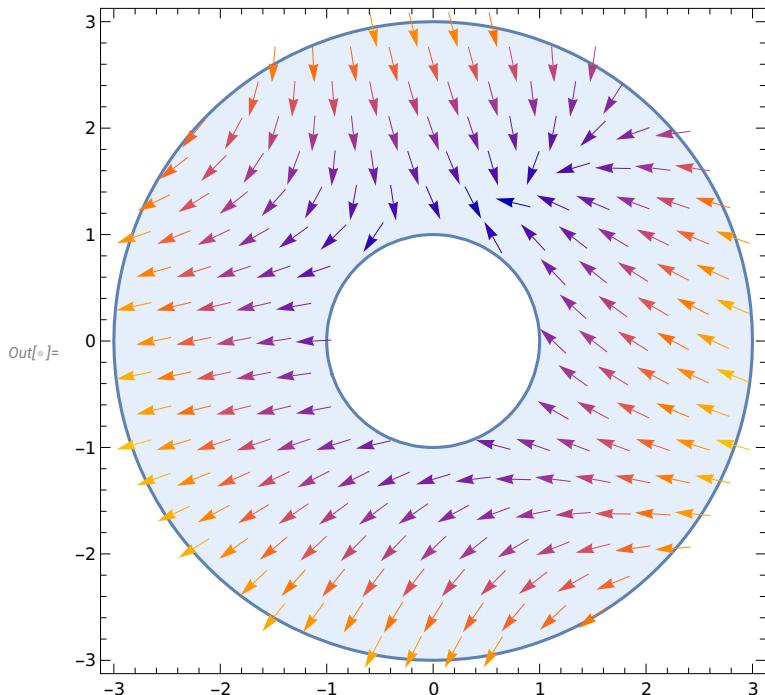
In[]:= (*phat=N[154/1000001]*)

In[]:= (*NProbability[a≥33,a≈EmpiricalDistribution[SimulationResults]]*)

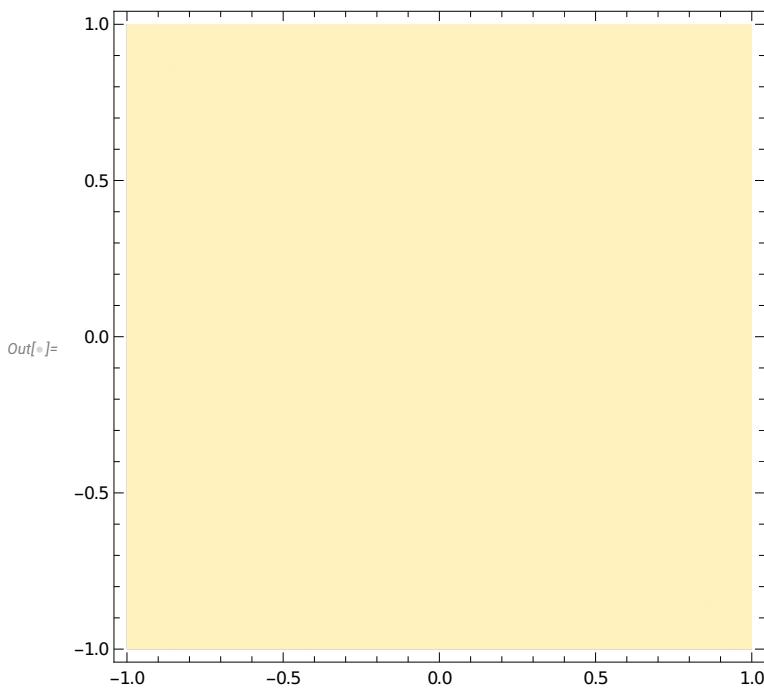
In[]:= (*finsimulationdistribution=FindDistribution[SimulationResults]*)
```

```
In[]:= (*NProbability[a≥33,a≈finsimulationdistribution]*)
```

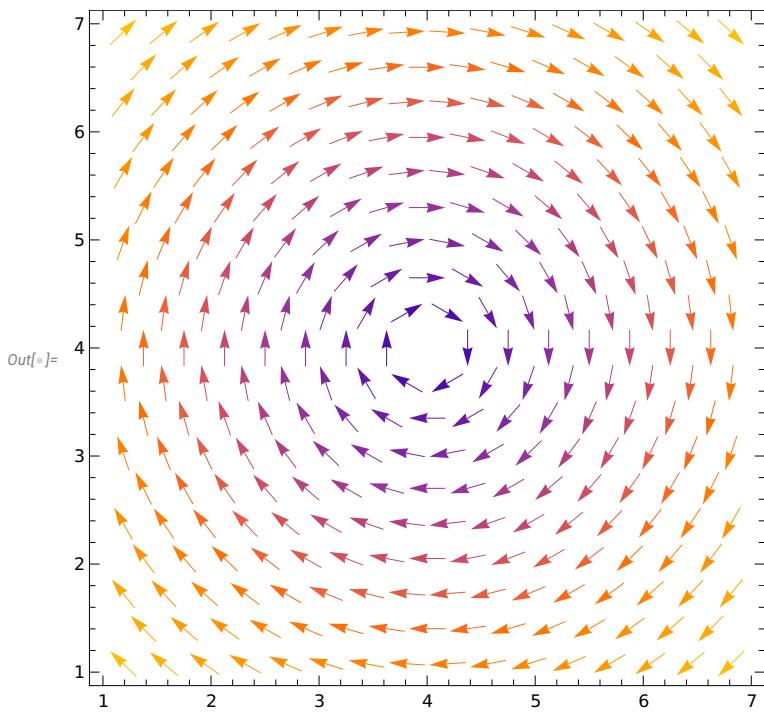
```
VectorPlot[{-1-x^2+y, 1+x-y^2}, {x, -3, 3},
{y, -3, 3}, RegionFunction → ContourPlot[x^2-y^2, {x, -3, 3},
{y, -3, 3}, RegionFunction → Function[{x, y, z}, 2 < x^2+y^2 < 9]]]
```



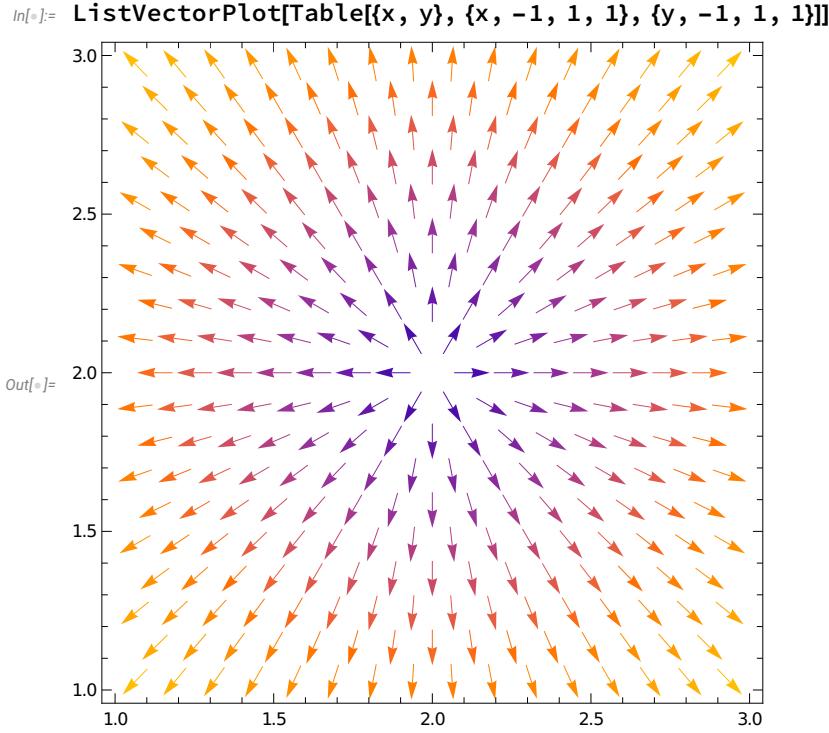
In[1]:= `ContourPlot[Table[{x, y}, {x, -1, 1, 1}, {y, -1, 1, 1}], {x, -1, 1}, {y, -1, 1}]`



Out[1]= `ListVectorPlot[Table[{y, -x}, {x, -3, 3, 1}, {y, -3, 3, 1}]]`



`{\{0, 1\}, \{-1, -1\}, \{1, -1\}}`



In[2]:= `CloudExport[`
`Import["/home/rko/Documents/Wolfram Desktop/Asteroids1211/META RESULTS.csv"],`
`"CSV", "Minor Planet Meta Results", Permissions → "Public"]`

Out[2]= `CloudObject[https://www.wolframcloud.com/obj/renay.oshop/Minor Planet Meta Results]`

In[3]:= `CopyToClipboard[CloudObject[`
`"https://www.wolframcloud.com/obj/renay.oshop/Minor Planet Meta Results"][[1]]]`

In[4]:= `CloudExport[Import["/home/rko/Documents/Wolfram`
`Desktop/Asteroids1211/minor planets names to search.csv"],`
`"CSV", "Minor Planet Names to Search", Permissions → "Public"]`

Out[4]= `CloudObject[https://www.wolframcloud.com/obj/renay.oshop/Minor Planet Names to Search]`

In[5]:= `CopyToClipboard[CloudObject[`
`"https://www.wolframcloud.com/obj/renay.oshop/Minor Planet Names to Search"][[1]]]`

In[6]:= `a = {0, 1, 1}; b = {-1, -1, 1}; c = {1, -1, 1};`

In[7]:= `Cross[a, b]`

Out[7]= `{2, -1, 1}`

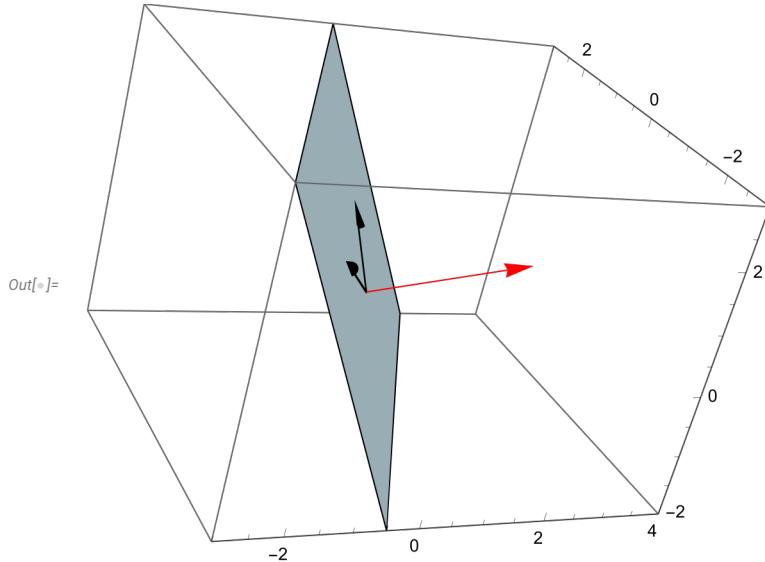
In[1]:= **Cross[b, c]**

Out[1]= {0, 2, 2}

In[2]:= **Cross[c, b]**

Out[2]= {0, -2, -2}

In[3]:= **Graphics3D[{Black, Arrow[Tube[{{0, 0, 0}, a}]], Arrow[Tube[{{0, 0, 0}, b}]], Red, Arrow[{{0, 0, 0}, Cross[a, b]}], White, InfinitePlane[{0, 0, 0}, {a, b}]], Axes → True, PlotRangePadding → 2}]**



In[4]:= **a = {-1, 1, 1}; b = {1, 1, 1}; c = {-1, -1, 1}; d = {1, -1, 1};**

In[5]:= **Cross[a, b]**

Out[5]= {0, 2, -2}

In[6]:= **Cross[b, c]**

Out[6]= {2, -2, 0}

In[7]:= **Cross[c, d]**

Out[7]= {0, 2, 2}

In[8]:= **Cross[b, c]**

Out[8]= {2, -2, 0}

In[9]:= **Cross[d, a]**

Out[9]= {-2, -2, 0}

In[10]:= **Cross[a, d]**

Out[10]= {2, 2, 0}

In[]:= {2, 2, 0}.a*d

Out[]:= 8