IntroToPolyGen.txt
IntroToPolyGen.pdf

Welcome to PolyGen.exe
A Free, Powerful, Even-Order Polynomial Coefficient Generator:
Exact by default to:
8th order & 2,000+ coefficients.
Real (non-exact) by custom configuration to:
20th order & 2,000+ coefficients

The enabling math & tech:
Computing adjoints and determinants involve no division;
hence any matrix with integer coefficients
has an inverse with exact rational coefficients.
&
Real*16 (128-bit) variables have 31 significant digits;
which supports tracking integer values up to 1 octillion.
Adjoint integers grow faster than the determinant integers.
My (this) cookbook reverse-engineers the key 2,4,6,& 8th order
integer divisors which exactify the real*16 inversion results
when rounded to the nearest integer.
[PolyGen.f95 - source code lines #337-#340.]

The computed coefficients are decoupled from one another,
so you can compute just one, or a few, if you so choose.
The central accomplishment of matrix inversion itself
is completely decoupled quantification wherein
outputs `reverse-engineer` inputs. Consider that:
'Higher powers' existing in exact -and- predictive harmony
resembles a breath of fresh air in the world of social thought.

Measurement noise(s) will degrade higher power coefficients.
Fortunately real*8 and real*16 math models bypass the noise problem.

Your rsults will go wild if you sample
on a domain that has discontinuous derivatives.

Trying to quantify exact higher power coefficients
in a noisy data environment is a fool's errand.
Therein use PseudoInverse Analysis, e.g. my 'Tweak-Engine',
& oversampling instead.

Elsewhere on my website, in source file Tweak-Engine.f95,
dated 2018.10.09, lines #895-#903, you'll see two examples
which were my first intentional use of exact inverses.

The Exact polynomial Generator is similar to
Genachi Taguchi's "Designed Experiments" templates
in that exact Coe[,] arrays form post-inversion
~ addative solution spaces.

Link: http://ftp.setterholm.com/ExactInversePolynomials/PolyGen.zip
Analyst: Jeff Setterholm Lakeville MN 55044 USA Thursday 2020.04.08

```
  ********, PolyGen.exe is post-copyright i.e.:FREE ,********
            ^ Version 1.0   04/06/2021  06:11 AM
  ********, Polyize.exe is post-copyright i.e.:FREE ,********
            ^ Version 1.1   04/06/2021  04:43 PM

  My legal disclaimer:
  ******************************************************
  ********   Individual cognition is always flawed   ********
  ********           including yours & mine.         ********
  ********                   - So: -                 ********
  ********     Use these results at your own risk.   ********
  ******************************************************
           Mitigate malfunctions. Nurture synergies.

!-------------------------------------------------------------------------------

PolyGen.exe & Polyize.exe runs on my WinXP & Win10 computers.

Zip-Directory.txt summarizes the files provided.

\Source-ColorCodedPdf - has the three color-coded the Fortran 95 source files.
                        Comments are in red.
                        My compiler is Absoft Pro Fortran 9.0, 2004.
                        1948 lines of code total.

!-------------------------------------------------------------------------------

Times associated with generating a pair of example matrices:
!--- Start                                              2021.03.31.1754.23.109

PolyGen.ini
1, 4                    !#of independent variables  [1,2,3,4,5,6,7,8,9,10]
2,8,8,2,2               !Order (power) for each variable
3, 1                    !Polynomial class: 1:exact, 2:Unscaled
4, 218422.              !Time estimate coefficient (from my 2004 computer)
0,                      !///Ends the .ini file read///

          729, :# of Poly Coeff`s
!--- Data entry - done                                  2021.03.31.1754.23.125
!---                                      task`s time:           .    .  . 16
!--- Powers matrix - done                               2021.03.31.1754.23.953
!---                                      task`s time:           .    .  .828
!--- Powers matrix - inverted                           2021.03.31.1757.01.203
!---                                      task`s time:           .   2.37.250
!--- Coeffs matrix - done                               2021.03.31.1757.01.343
!---                                      task`s time:           .    .  .140
 PCoesE42288.bin
Binary file data write/read sequence- integer*4`s & real*16`s:
           4, i* 4 nVT      -Number of independent variables   fixed size
           4, i* 4 nOrdMax  -Highest order variable              `    `
           4, i* 4 nCT      -Number of polynomial coefficients   `    `
```

```
          40, i* 4 nOrd(20) -Order of each variable              `    `
           4, i* 4 iPolyClass-=1:exact, =2:unscaled              `    `
           4, i* 4 iCoeDigits- +***.  <-count                    `    `
           4, i* 4 iCoeDeciPl-number of digits after .           `    `
          16, r*16 CoeDiv   -Coe[,] matrix dividing factor       `    `
          16, r*16 CoeMax   -AbsMax Coe[,] value after divide    `    `
           4, i* 4 iPowDigits- +***.  <-count                    `    `
           4, i* 4 iPowDeciPl-number of digits after .           `    `
          16, r*16 PowDiv   -Pow[,] matrix dividing factor       `    `
          16, r*16 PowMax   -AbsMax Pow[,] value after divide    `    `
         576, r*16 X[0:nOrdMax,nVT] -Variable values to use    allocated
       11664, i* 4 nVnC[nVT   ,nCT] -Values combinations sequence  `
     8503056, r*16 Coe[ nCT   ,nCT] -The coefficients solver       `
     8503056, r*16 Pow[ nCT   ,nCT]      Coe[,] = inverse(Pow[,])  `
    17018488, Total Bytes
          0.002            :write-time-minutes ballpark
!--- Binary file - exported 17,018,488, Total Bytes      2021.03.31.1757.01.562
!---                                        task`s time:           .    .  .219
!--- Done.                                               2021.03.31.1757.01.562
!---                                     Elapsed time:           .   2.38.453
                                                        year ^m ^d ^h^m ^s ^ms

!-------------------------------------------------------------------------------

In PolyGen.f95:  ~ Lines 28 -158   Key variables:
!-------------------------------------------------------------------------------7 9

Subroutine CoefficientCount(iP):

     Number of polynomial coefficients <= 9999  for 7 variables up to order 20

             Order of v1 = 0    2    4    6    8|  10   12   14   16   18   20

                         ----------------- <-exact|unscaled-> ------------------

   1             V2 = 0    1    3    5    7    9|  11   13   15   17   19   21

   2                  2         9   15   21   27|  33   39   45   51   57   63

   3                  4             25   35   45|  55   65   75   85   95  105

   4                  6                  49   63|  77   91  105  119  133  147

   5                  8                       81|  99  117  135  153  171  189

   6                 10                         | 121  143  165  187  209  231

   7                 12                         |      169  195  221  247  273

   8                 14                         |           225  255  285  315

   9                 16                         |                289  323  357
```

10		18									361	399
11	V3 = 0	20										441
12		2	2	27	45	63	81	99	117	135	153	171	189
13		2	4		75	105	135	165	195	225	255	285	315
14		2	6			147	189	231	273	315	357	399	441
15		2	8				243	297	351	405	459	513	567
16		2	10					363	429	495	561	627	693
17		2	12						507	585	663	741	819
18		2	14							675	765	855	945
19		2	16								867	969	1071
20		2	18									1083	1197
21		2	20										1323
22		4	4		125	175	225	275	325	375	425	475	525
23		4	6			245	315	385	455	525	595	665	735
24		4	8				405	495	585	675	765	855	945
25		4	10					605	715	825	935	1045	1155
26		4	12						845	975	1105	1235	1365
27		4	14							1125	1275	1425	1575
28		4	16								1445	1615	1785
29		4	18									1805	1995
30		4	20										2205
31		6	6			343	441	539	637	735	833	931	1029
32		6	8				567	693	819	945	1071	1197	1323
33		6	10					847	1001	1155	1309	1463	1617
34		6	12						1183	1365	1547	1729	1911
35		6	14							1575	1785	1995	2205

36	6	16				2023	2261	2499	
37	6	18					2527	2793	
38	6	20						3087	
39	8	8	729	891	1053	1215	1377	1539	1701
40	8	10		1089	1287	1485	1683	1881	2079
41	8	12			1521	1755	1989	2223	2457
42	8	14				2025	2295	2565	2835
43	8	16					2601	2907	3213
44	8	18						3249	3591
45	8	20							3969
46	10	10		1331	1573	1815	2057	2299	2541
47	10	12			1859	2145	2431	2717	3003
48	10	14				2475	2805	3135	3465
49	10	16					3179	3553	3927
50	10	18						3971	4389
51	10	20							4851
52	12	12			2197	2535	2873	3211	3549
53	12	14				2925	3315	3705	4095
54	12	16					3757	4199	4641
55	12	18						4693	5187
56	12	20							5733
57	14	14				3375	3825	4275	4725
58	14	16					4335	4845	5355
59	14	18						5415	5985
60	14	20							6615
61	16	16					4913	5491	6069

62			16	18							6137	6783	
63			16	20								7497	
64			18	18							6859	7581	
65			18	20								8379	
66	V4 = 0		20	20								9261	
67		2	2	2	81	135	189	243	297	351	405	459	513	567
68		2	2	4		225	315	405	495	585	675	765	855	945
69		2	2	6			441	567	693	819	945	1071	1197	1323
70		2	2	8				729	891	1053	1215	1377	1539	1701
71		2	2	10					1089	1287	1485	1683	1881	2079
72		2	2	12						1521	1755	1989	2223	2457
73		2	2	14							2025	2295	2565	2835
74		2	2	16								2601	2907	3213
75		2	2	18									3249	3591
76		2	2	20										3969
77		2	4	4		375	525	675	825	975	1125	1275	1425	1575
78		2	4	6			735	945	1155	1365	1575	1785	1995	2205
79		2	4	8				1215	1485	1755	2025	2295	2565	2835
80		2	4	10					1815	2145	2475	2805	3135	3465
81		2	4	12						2535	2925	3315	3705	4095
82		2	4	14							3375	3825	4275	4725
83		2	4	16								4335	4845	5355
84		2	4	18									5415	5985
85		2	4	20										6615
86		2	6	6				1029	1323	1617	1911	2205	2499	2793	3087
87		2	6	8					1701	2079	2457	2835	3213	3591	3969

88	2	6	10				2541	3003	3465	3927	4389	4851
89	2	6	12					3549	4095	4641	5187	5733
90	2	6	14						4725	5355	5985	6615
91	2	6	16							6069	6783	7497
92	2	6	18								7581	8379
93	2	6	20									9261
94	2	8	8			2187	2673	3159	3645	4131	4617	5103
95	2	8	10				3267	3861	4455	5049	5643	6237
96	2	8	12					4563	5265	5967	6669	7371
97	2	8	14						6075	6885	7695	8505
98	2	8	16							7803	8721	9639
99	2	8	18								9747	
100	2	10	10				3993	4719	5445	6171	6897	7623
101	2	10	12					5577	6435	7293	8151	9009
102	2	10	14						7425	8415	9405	
103	2	10	16							9537		
104	2	12	12					6591	7605	8619	9633	
105	2	12	14						8775	9945		
106	4	4	4		625	875	1125	1375	1625	1875	2125	2375	2625
107	4	4	6			1225	1575	1925	2275	2625	2975	3325	3675
108	4	4	8			2025	2475	2925	3375	3825	4275	4725
109	4	4	10				3025	3575	4125	4675	5225	5775
110	4	4	12					4225	4875	5525	6175	6825
111	4	4	14						5625	6375	7125	7875
112	4	4	16							7225	8075	8925
113	4	4	18								9025	9975

```
114            4  6  6                1715 2205|2695 3185 3675 4165 4655 5145
115            4  6  8                     2835|3465 4095 4725 5355 5985 6615
116            4  6 10                         |4235 5005 5775 6545 7315 8085
117            4  6 12                         |     5915 6825 7735 8645 9555
118            4  6 14                         |          7875 8925 9975
119            4  8  8                     3645|4455 5265 6075 6885 7695 8505
120            4  8 10                         |5445 6435 7425 8415 9405
121            4  8 12                         |     7605 8775 9945
122            4 10 10                         |6655 7865 9075
123            4 10 12                         |     9295
124            6  6  6                2401 3087|3773 4459 5145 5831 6517 7203
125            6  6  8                     3969|4851 5733 6615 7497 8379 9261
126            6  6 10                         |5929 7007 8085 9163
127            6  6 12                         |     8281 9555
128            6  8  8                     5103|6237 7371 8505 9639
129            6  8 10                         |7623 9009
130            6 10 10                         |9317
131            8  8  8                     6561|8019 9477
132    V5 = 0  8  8 10                         |9801
133         2  2  2  2       243  405  567  729| 891 1053 1215 1377 1539 1701
134         2  2  2  4            675  945 1215|1485 1755 2025 2295 2565 2835
135         2  2  2  6                1323 1701|2079 2457 2835 3213 3591 3969
136         2  2  2  8                     2187|2673 3159 3645 4131 4617 5103
137         2  2  2 10                         |3267 3861 4455 5049 5643 6237
138         2  2  2 12                         |     4563 5265 5967 6669 7371
139         2  2  2 14                         |          6075 6885 7695 8505
```

```
140          2  2  2 16                        |               7803 8721 9639
141          2  2  2 18                        |                    9747
142          2  2  4  4           1125 1575 2025|2475 2925 3375 3825 4275 4725
143          2  2  4  6                2205 2835|3465 4095 4725 5355 5985 6615
144          2  2  4  8                     3645|4455 5265 6075 6885 7695 8505
145          2  2  4 10                         |5445 6435 7425 8415 9405
146          2  2  4 12                         |     7605 8775 9945
147          2  2  6  6                3087 3969|4851 5733 6615 7497 8379 9261
148          2  2  6  8                     5103|6237 7371 8505 9639
149          2  2  6 10                         |7623 9009
150          2  2  8  8                     6561|8019 9477
151          2  2  8 10                         |9801
152          2  4  4  4           1875 2625 3375|4125 4875 5625 6375 7125 7875
153          2  4  4  6                3675 4725|5775 6825 7875 8925 9975
154          2  4  4  8                     6075|7425 8775
155          2  4  4 10                         |9075
156          2  4  6  6                5145 6615|8085 9555
157          2  4  6  8                     8505|
158          2  6  6  6                7203 9261|
159          4  4  4  4           3125 4375 5625|6875 8125 9375
160          4  4  4  6                6125 7875|9625
161 V6 = 0   4  4  6  6                8575     |
162       2  2  2  2  2       729 1215 1701 2187|2673 3159 3645 4131 4617 5103
163       2  2  2  2  4           2025 2835 3645|4455 5265 6075 6885 7695 8505
164       2  2  2  2  6                3969 5103|6237 7371 8505 9639
165       2  2  2  2  8                     6561|8019 9477
```

```
166      2  2  2  2 10                        |9801
167      2  2  2  4  4           3375 4725 6075|7425 8775
168      2  2  2  4  6                6615 8505|
169      2  2  2  6  6                9261     |
170      2  2  4  4  4           5625 7875     |
171V7=0  2  4  4  4  4           9375          |
172   2  2  2  2  2  2      2187 3645 5103 6561|8019 9477
173   2  2  2  2  2  4           6075 8505     |
                     ----------------- <-exact|unscaled-> ------------------
```