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In [3]: # Here we define the ij-th entry of eigenmatrix for any parameters.
# We use the inbuilt functions: binomial, and q_binomial of Sagemath.
def Q(d,q,i,j):
    l = min(j,d-i)
    return sum(((−1)^j)*((−q)^(binomial(j−h,2)+h*d))*(q_binomial(d−h,d−j,−q))*(q_binomial(d−h,d−j,−q))
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In [4]: # Here we define the eigenmatrix of Hermitian forms graphs for any d and q.
def P_Matrix(d,q):
    return matrix(SR, d+1, d+1, lambda i, j: Q(d,q,i,j))
```

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In [36]: # Here we verify the conjectures for q=2 and d=2,3,4,5.
show("q=2, d=2:",P_Matrix(2,2));
show("q=2, d=3:",P_Matrix(3,2));
show("q=2, d=4:",P_Matrix(4,2));
show("q=2, d=5:",P_Matrix(5,2))
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$$q=2, d=2: \begin{pmatrix} 1 & 5 & 10 \\ 1 & -3 & 2 \\ 1 & 1 & -2 \end{pmatrix}$$

$$q=2, d=3: \begin{pmatrix} 1 & 21 & 210 & 280 \\ 1 & -11 & 50 & -40 \\ 1 & 5 & 2 & -8 \\ 1 & -3 & -6 & 8 \end{pmatrix}$$

$$q=2, d=4: \begin{pmatrix} 1 & 85 & 3570 & 23800 & 38080 \\ 1 & -43 & 882 & -3080 & 2240 \\ 1 & 21 & 178 & 120 & -320 \\ 1 & -11 & 18 & 56 & -64 \\ 1 & 5 & -30 & -40 & 64 \end{pmatrix}$$

$$q=2, d=5: \begin{pmatrix} 1 & 341 & 57970 & 1623160 & 12985280 & 18887680 \\ 1 & -171 & 14450 & -204680 & 799680 & -609280 \\ 1 & 85 & 3442 & 21112 & 11200 & -35840 \\ 1 & -43 & 754 & -1672 & -4160 & 5120 \\ 1 & 21 & 50 & -520 & -576 & 1024 \\ 1 & -11 & -110 & 440 & 704 & -1024 \end{pmatrix}$$

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In [35]: # Here we verify the conjectures for q=3 and d=2,3,4,5.
show("q=3, d=2:", P_Matrix(2,3));
show("q=3, d=3:", P_Matrix(3,3));
show("q=3, d=4:", P_Matrix(4,3));
show("q=3, d=5:", P_Matrix(5,3))
```

$$q=3, d=2: \begin{pmatrix} 1 & 20 & 60 \\ 1 & -7 & 6 \\ 1 & 2 & -3 \end{pmatrix}$$

$$q=3, d=3: \begin{pmatrix} 1 & 182 & 5460 & 14040 \\ 1 & -61 & 600 & -540 \\ 1 & 20 & 33 & -54 \\ 1 & -7 & -21 & 27 \end{pmatrix}$$

$$q=3, d=4: \begin{pmatrix} 1 & 1640 & 447720 & 11512800 & 31084560 \\ 1 & -547 & 49686 & -428220 & 379080 \\ 1 & 182 & 5217 & 9180 & -14580 \\ 1 & -61 & 357 & 1161 & -1458 \\ 1 & 20 & -210 & -540 & 729 \end{pmatrix}$$

$$q=3, d=5: \begin{pmatrix} 1 & 14762 & 36314520 & 8497597680 & 229435137360 & 609319545120 \\ 1 & -4921 & 4034400 & -314875080 & 2828694960 & -2517849360 \\ 1 & 1640 & 445533 & 11114766 & 19143540 & -30705480 \\ 1 & -547 & 47499 & -294813 & -933120 & 1180980 \\ 1 & 182 & 3030 & -34560 & -86751 & 118098 \\ 1 & -61 & -1830 & 16470 & 44469 & -59049 \end{pmatrix}$$

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In [ ]:
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