```
> with(LinearAlgebra) :
> interface(rtablesize = 40) :
>
```

We consider the following reactions: this simple assume that the scaffold protein when bound with K (or S) will change the docking of S, (for example, steric effect, where allosteric is not considered). To simplify as purpose of easy analysis, we assume there is high scaffold protein concentration which allows the linear (first order) reaction of K <-> K(bound).

K + S <-> KS -> K + Sp
sK + S <-> sKS -> sK + Sp
Sp->S
K <-> sK
KS <-> sKS

$$K + S \rightleftharpoons KS \rightarrow K + S_p$$
$$sK + S \rightleftharpoons sKS \rightarrow sK + S_p$$
$$K \rightleftharpoons sK$$
$$S_p \rightarrow S$$
$$KS \rightleftharpoons sKS$$

The species of the networ are (in parentesis the order in which I consider them)

{S (1) , Sp (2) , K (3) , sK (4), KS (5), sKS (6)}

There are a total of 11 reactions and 6 species.

I construct the mass-action ODE system by defining the stoichiometric matrix A, and the vector of rates "krates".
Then, the ODE system is

$$\frac{dx}{dt} = A \cdot k_{rs}$$

and hence steady states are given as $A \cdot k_{rs} = 0$.

Stoichiometric matrix:

I enter first the reactions as rows and then transpose the matrix

```
> A := Matrix(11, 6) :
> A[1, 1] := -1 : A[1, 3] := -1 : A[1, 5] := 1 : A[2] := -A[1] :
> A[3, 3] := 1 : A[3, 2] := 1 : A[3, 5] := -1 :
> A[4, 1] := -1 : A[4, 4] := -1 : A[4, 6] := 1 : A[5] := -A[4] :
```

> $A[6,4] := 1 : A[6,2] := 1 : A[6,6] := -1 :$
> $A[7,2] := -1 : A[7,1] := 1 :$
> $A[8,3] := -1 : A[8,4] := 1 : A[9] := -A[8] :$
> $A[10,5] := -1 : A[10,6] := 1 : A[11] := -A[10] :$
> $A := Transpose(A) :$
>

Vector of rates:

here x_i is the concentration of the i-th species

> $ks := Vector([k_1 \cdot x_3 \cdot x_1, k_2 \cdot x_5, k_3 \cdot x_5, k_4 \cdot x_4 \cdot x_1, k_5 \cdot x_6, k_6 \cdot x_6, k_7 \cdot x_2, k_8 \cdot x_3, k_9 \cdot x_4, k_{10} \cdot x_5, k_{11} \cdot x_6])$

$$ks := \begin{bmatrix} k_1 x_3 x_1 \\ k_2 x_5 \\ k_3 x_5 \\ k_4 x_4 x_1 \\ k_5 x_6 \\ k_6 x_6 \\ k_7 x_2 \\ k_8 x_3 \\ k_9 x_4 \\ k_{10} x_5 \\ k_{11} x_6 \end{bmatrix} \quad \mathbf{(1)}$$

Steady state equations:

> $ssEqs := A.ks$

(2)

$$ssEqs := \begin{bmatrix} -k_1 x_1 x_3 - k_4 x_1 x_4 + k_2 x_5 + k_5 x_6 + k_7 x_2 \\ k_3 x_5 + k_6 x_6 - k_7 x_2 \\ -k_1 x_1 x_3 + k_2 x_5 + k_3 x_5 - k_8 x_3 + k_9 x_4 \\ -k_4 x_1 x_4 + k_5 x_6 + k_6 x_6 + k_8 x_3 - k_9 x_4 \\ k_1 x_1 x_3 - k_2 x_5 - k_3 x_5 - k_{10} x_5 + k_{11} x_6 \\ k_4 x_1 x_4 - k_5 x_6 - k_6 x_6 + k_{10} x_5 - k_{11} x_6 \end{bmatrix} \quad (2)$$

Conservation laws:

This system has total amount of kinase and total amount of substrate conserved:

> $F := ReducedRowEchelonForm(Transpose(Matrix([op(NullSpace(Transpose(A)))])))$

$$F := \begin{bmatrix} 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 1 \end{bmatrix} \quad (3)$$

>

the conservation laws are:

$x_1 + x_2 + x_5 + x_6 - T_1, x_3 + x_4 + x_5 + x_6 - T_2$

Therefore, the steady states constrained by the conservation laws are solutions to myeqs=0
(because there are two conservation laws, two of the equations in eqs can be disregarded).

> $subsEqs := [ssEqs[2], ssEqs[4], ssEqs[5], ssEqs[6], x_1 + x_2 + x_5 + x_6 - T_1, x_3 + x_4 + x_5 + x_6 - T_2]$

$$subsEqs := [k_3 x_5 + k_6 x_6 - k_7 x_2, -k_4 x_1 x_4 + k_5 x_6 + k_6 x_6 + k_8 x_3 - k_9 x_4, k_1 x_1 x_3 - k_2 x_5 - k_3 x_5 - k_{10} x_5 + k_{11} x_6, k_4 x_1 x_4 - k_5 x_6 - k_6 x_6 + k_{10} x_5 - k_{11} x_6, x_1 + x_2 + x_5 + x_6 - T_1, x_3 + x_4 + x_5 + x_6 - T_2] \quad (4)$$

Computations

The way to find different sets of parameters is highlighted in bold. These are two steps where there is a choice.

We compute the Jacobian of myeqs (steady state equations together with the conservation laws)

> $J := VectorCalculus[Jacobian](subsEqs, [seq(x[i], i = 1..6)])$

$$J := \begin{bmatrix} 0 & -k_7 & 0 & 0 & k_3 & k_6 \\ -k_4 x_4 & 0 & k_8 & -k_4 x_1 - k_9 & 0 & k_5 + k_6 \\ k_1 x_3 & 0 & k_1 x_1 & 0 & -k_2 - k_3 - k_{10} & k_{11} \\ k_4 x_4 & 0 & 0 & k_4 x_1 & k_{10} & -k_5 - k_6 - k_{11} \\ 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 1 \end{bmatrix} \quad (1.1)$$

> $Determinant(J)$:

> $detJ := collect(\%, \{seq(x[i], i = 1..6)\}, 'distributed')$

$$detJ := (-k_1 k_4 k_7 k_{10} - k_1 k_4 k_7 k_{11}) x_1^2 + (-k_1 k_3 k_4 k_8 - k_1 k_3 k_4 k_{11} + k_1 k_4 k_6 k_8 - k_1 k_4 k_6 k_{10} - k_1 k_4 k_7 k_{10} - k_1 k_4 k_7 k_{11}) x_1 x_3 + (k_1 k_3 k_4 k_9 - k_1 k_3 k_4 k_{11} - k_1 k_4 k_6 k_9 - k_1 k_4 k_6 k_{10} - k_1 k_4 k_7 k_{10} - k_1 k_4 k_7 k_{11}) x_1 x_4 + (-k_1 k_5 k_7 k_9 - k_1 k_5 k_7 k_{10} - k_1 k_6 k_7 k_9 - k_1 k_6 k_7 k_{10} - k_1 k_7 k_9 k_{10} - k_1 k_7 k_9 k_{11} - k_2 k_4 k_7 k_8 - k_2 k_4 k_7 k_{11} - k_3 k_4 k_7 k_8 - k_3 k_4 k_7 k_{11} - k_4 k_7 k_8 k_{10} - k_4 k_7 k_8 k_{11}) x_1 + (-k_1 k_3 k_5 k_8 - k_1 k_3 k_5 k_9 - k_1 k_3 k_6 k_8 - k_1 k_3 k_6 k_9 - k_1 k_3 k_8 k_{11} - k_1 k_3 k_9 k_{11} - k_1 k_5 k_7 k_8 - k_1 k_5 k_7 k_9 - k_1 k_6 k_7 k_8 - k_1 k_6 k_7 k_9 - k_1 k_6 k_8 k_{10} - k_1 k_6 k_9 k_{10} - k_1 k_7 k_8 k_{10} - k_1 k_7 k_8 k_{11} - k_1 k_7 k_9 k_{10} - k_1 k_7 k_9 k_{11}) x_3 + (-k_2 k_4 k_6 k_8 - k_2 k_4 k_6 k_9 - k_2 k_4 k_7 k_8 - k_2 k_4 k_7 k_9 - k_3 k_4 k_6 k_8 - k_3 k_4 k_6 k_9 - k_3 k_4 k_7 k_8 - k_3 k_4 k_7 k_9 - k_3 k_4 k_8 k_{11} - k_3 k_4 k_9 k_{11} - k_4 k_6 k_8 k_{10} - k_4 k_6 k_9 k_{10} - k_4 k_7 k_8 k_{10} - k_4 k_7 k_8 k_{11} - k_4 k_7 k_9 k_{10} - k_4 k_7 k_9 k_{11}) x_4 - k_2 k_5 k_7 k_8 - k_2 k_5 k_7 k_9 - k_2 k_6 k_7 k_8 - k_2 k_6 k_7 k_9 - k_2 k_7 k_8 k_{11} - k_2 k_7 k_9 k_{11} - k_3 k_5 k_7 k_8 - k_3 k_5 k_7 k_9 - k_3 k_6 k_7 k_8 - k_3 k_6 k_7 k_9 - k_3 k_7 k_8 k_{11} - k_3 k_7 k_9 k_{11} - k_5 k_7 k_8 k_{10} - k_5 k_7 k_9 k_{10} - k_6 k_7 k_8 k_{10} - k_6 k_7 k_9 k_{10} \quad (1.2)$$

We parameterise the steady states as functions of x1 and x3, using the four steady state equations:
When x1 and x3 are positive, then so are the rest.

> $solution := solve([subsEqs[1], subsEqs[2], subsEqs[3], subsEqs[4]], [x[2], x[4], x[5], x[6]])$

(1.3)

$$solution := \Big[\Big[x_2 = \big(\big(k_1 k_3 k_4 k_{11} x_1 + k_1 k_4 k_6 k_{10} x_1 + k_1 k_3 k_5 k_9 + k_1 k_3 k_6 k_9 + k_1 k_3 k_9 k_{11} + k_1 k_6 k_9 k_{10} + k_2 k_4 k_6 k_8 + k_3 k_4 k_6 k_8 + k_3 k_4 k_8 k_{11} + k_4 k_6 k_8 k_{10}\big) x_1 x_3\big) \Big/ \big(k_7 \big(k_2 k_4 k_{11} x_1 + k_3 k_4 k_{11} x_1 + k_2 k_5 k_9 + k_2 k_6 k_9 + k_2 k_9 k_{11} + k_3 k_5 k_9 + k_3 k_6 k_9 + k_3 k_9 k_{11} + k_5 k_9 k_{10} + k_6 k_9 k_{10}\big)\big), x_4 = \big(x_3 \big(k_1 k_5 k_{10} x_1 + k_1 k_6 k_{10} x_1 + k_2 k_5 k_8 + k_2 k_6 k_8 + k_2 k_8 k_{11} + k_3 k_5 k_8 + k_3 k_6 k_8 + k_3 k_8 k_{11} + k_5 k_8 k_{10} + k_6 k_8 k_{10}\big)\big) \Big/ \big(k_2 k_4 k_{11} x_1 + k_3 k_4 k_{11} x_1 + k_2 k_5 k_9 + k_2 k_6 k_9 + k_2 k_9 k_{11} + k_3 k_5 k_9 + k_3 k_6 k_9 + k_3 k_9 k_{11} + k_5 k_9 k_{10} + k_6 k_9 k_{10}\big), x_5 = \big(x_1 x_3 \big(k_1 k_4 k_{11} x_1 + k_1 k_5 k_9 + k_1 k_6 k_9 + k_1 k_9 k_{11} + k_4 k_8 k_{11}\big)\big) \Big/ \big(k_2 k_4 k_{11} x_1 + k_3 k_4 k_{11} x_1 + k_2 k_5 k_9 + k_2 k_6 k_9 + k_2 k_9 k_{11} + k_3 k_5 k_9 + k_3 k_6 k_9 + k_3 k_9 k_{11} + k_5 k_9 k_{10} + k_6 k_9 k_{10}\big), x_6 = \big(\big(k_1 k_4 k_{10} x_1 + k_1 k_9 k_{10} + k_2 k_4 k_8 + k_3 k_4 k_8 + k_4 k_8 k_{10}\big) x_1 x_3\big) \Big/ \big(k_2 k_4 k_{11} x_1 + k_3 k_4 k_{11} x_1 + k_2 k_5 k_9 + k_2 k_6 k_9 + k_2 k_9 k_{11} + k_3 k_5 k_9 + k_3 k_6 k_9 + k_3 k_9 k_{11} + k_5 k_9 k_{10} + k_6 k_9 k_{10}\big)\Big]\Big] \quad \textbf{(1.3)}$$

We evaluate the determinant of the Jacobian at the parameterisation. We then write it as a polynomial in x1 and x3

> $detSubs := subs(solution[1], detJ):$

> $polSubs := numer(detSubs):$

> $finalPol := collect\big(polSubs, \{x_1, x_3\}, 'distributed'\big)$

$$finalPol := -4 k_2 k_3 k_5 k_6 k_7 k_8 k_9 - 4 k_2 k_3 k_5 k_7 k_8 k_9 k_{11} - 4 k_2 k_3 k_6 k_7 k_8 k_9 k_{11} - 4 k_2 k_5 k_6 k_7 k_8 k_9 k_{10} - 2 k_2 k_5 k_7 k_8 k_9 k_{10} k_{11} - 2 k_2 k_6 k_7 k_8 k_9 k_{10} k_{11} - 4 k_3 k_5 k_6 k_7 k_8 k_9 k_{10} - 2 k_3 k_5 k_7 k_8 k_9 k_{10} k_{11} - 2 k_3 k_6 k_7 k_8 k_9 k_{10} k_{11} - 2 k_3^2 k_5 k_7 k_8 k_9 k_{11} - 2 k_3^2 k_6 k_7 k_8 k_9 k_{11} - 2 k_3 k_5^2 k_7 k_8 k_9 k_{10} - 4 k_3 k_5 k_6 k_7 k_9^2 k_{10} - 2 k_3 k_5 k_7 k_9^2 k_{10} k_{11} - 2 k_3 k_6^2 k_7 k_8 k_9 k_{10} - 2 k_3 k_6 k_7 k_9^2 k_{10} k_{11} - 2 k_5 k_6 k_7 k_8 k_9 \quad \textbf{(1.4)}$$

$$k_{10}^2 - 2\,k_2^2\,k_5\,k_6\,k_7\,k_8\,k_9 - 2\,k_2^2\,k_5\,k_7\,k_8\,k_9\,k_{11} - 2\,k_2^2\,k_6\,k_7\,k_8\,k_9\,k_{11} - 2\,k_2\,k_3\,k_5^2\,k_7\,k_8\,k_9$$
$$- 4\,k_2\,k_3\,k_5\,k_6\,k_7\,k_9^2 - 4\,k_2\,k_3\,k_5\,k_7\,k_9^2\,k_{11} - 2\,k_2\,k_3\,k_6^2\,k_7\,k_8\,k_9 - 4\,k_2\,k_3\,k_6\,k_7\,k_9^2\,k_{11}$$
$$- 2\,k_2\,k_3\,k_7\,k_8\,k_9\,k_{11}^2 - 2\,k_2\,k_5^2\,k_7\,k_8\,k_9\,k_{10} - 4\,k_2\,k_5\,k_6\,k_7\,k_9^2\,k_{10} - 2\,k_2\,k_5\,k_7\,k_9^2\,k_{10}\,k_{11}$$
$$- 2\,k_2\,k_6^2\,k_7\,k_8\,k_9\,k_{10} - 2\,k_2\,k_6\,k_7\,k_9^2\,k_{10}\,k_{11} - 2\,k_3^2\,k_5\,k_6\,k_7\,k_8\,k_9 + \big(-k_1\,k_2\,k_5^2\,k_7\,k_9^2$$
$$- k_1\,k_2\,k_5^2\,k_7\,k_9\,k_{10} - 2\,k_1\,k_2\,k_5\,k_6\,k_7\,k_9^2 - 2\,k_1\,k_2\,k_5\,k_6\,k_7\,k_9\,k_{10} - k_1\,k_2\,k_5\,k_7\,k_9^2\,k_{10}$$
$$- 2\,k_1\,k_2\,k_5\,k_7\,k_9^2\,k_{11} - k_1\,k_2\,k_5\,k_7\,k_9\,k_{10}\,k_{11} - k_1\,k_2\,k_6^2\,k_7\,k_9^2 - k_1\,k_2\,k_6^2\,k_7\,k_9\,k_{10}$$
$$- k_1\,k_2\,k_6\,k_7\,k_9^2\,k_{10} - 2\,k_1\,k_2\,k_6\,k_7\,k_9^2\,k_{11} - k_1\,k_2\,k_6\,k_7\,k_9\,k_{10}\,k_{11} - k_1\,k_2\,k_7\,k_9^2\,k_{10}\,k_{11}$$
$$- k_1\,k_2\,k_7\,k_9^2\,k_{11}^2 - k_1\,k_3\,k_5^2\,k_7\,k_9^2 - k_1\,k_3\,k_5^2\,k_7\,k_9\,k_{10} - 2\,k_1\,k_3\,k_5\,k_6\,k_7\,k_9^2$$
$$- 2\,k_1\,k_3\,k_5\,k_6\,k_7\,k_9\,k_{10} - k_1\,k_3\,k_5\,k_7\,k_9^2\,k_{10} - 2\,k_1\,k_3\,k_5\,k_7\,k_9^2\,k_{11}$$
$$- k_1\,k_3\,k_5\,k_7\,k_9\,k_{10}\,k_{11} - k_1\,k_3\,k_6^2\,k_7\,k_9^2 - k_1\,k_3\,k_6^2\,k_7\,k_9\,k_{10} - k_1\,k_3\,k_6\,k_7\,k_9^2\,k_{10}$$
$$- 2\,k_1\,k_3\,k_6\,k_7\,k_9^2\,k_{11} - k_1\,k_3\,k_6\,k_7\,k_9\,k_{10}\,k_{11} - k_1\,k_3\,k_7\,k_9^2\,k_{10}\,k_{11} - k_1\,k_3\,k_7\,k_9^2\,k_{11}^2$$
$$- k_1\,k_5^2\,k_7\,k_9^2\,k_{10} - k_1\,k_5^2\,k_7\,k_9\,k_{10}^2 - 2\,k_1\,k_5\,k_6\,k_7\,k_9^2\,k_{10} - 2\,k_1\,k_5\,k_6\,k_7\,k_9\,k_{10}^2$$
$$- k_1\,k_5\,k_7\,k_9^2\,k_{10}^2 - k_1\,k_5\,k_7\,k_9^2\,k_{10}\,k_{11} - k_1\,k_6^2\,k_7\,k_9^2\,k_{10} - k_1\,k_6^2\,k_7\,k_9\,k_{10}^2 - k_1\,k_6\,k_7\,k_9^2$$
$$k_{10}^2 - k_1\,k_6\,k_7\,k_9^2\,k_{10}\,k_{11} - k_2^2\,k_4\,k_5\,k_7\,k_8\,k_9 - k_2^2\,k_4\,k_5\,k_7\,k_8\,k_{11} - 2\,k_2^2\,k_4\,k_5\,k_7\,k_9\,k_{11} -$$
$$k_2^2\,k_4\,k_6\,k_7\,k_8\,k_9 - k_2^2\,k_4\,k_6\,k_7\,k_8\,k_{11} - 2\,k_2^2\,k_4\,k_6\,k_7\,k_9\,k_{11} - k_2^2\,k_4\,k_7\,k_8\,k_9\,k_{11} -$$
$$k_2^2\,k_4\,k_7\,k_8\,k_{11}^2 - 2\,k_2^2\,k_4\,k_7\,k_9\,k_{11}^2 - 2\,k_2\,k_3\,k_4\,k_5\,k_7\,k_8\,k_9 - 2\,k_2\,k_3\,k_4\,k_5\,k_7\,k_8\,k_{11}$$
$$- 4\,k_2\,k_3\,k_4\,k_5\,k_7\,k_9\,k_{11} - 2\,k_2\,k_3\,k_4\,k_6\,k_7\,k_8\,k_9 - 2\,k_2\,k_3\,k_4\,k_6\,k_7\,k_8\,k_{11}$$
$$- 4\,k_2\,k_3\,k_4\,k_6\,k_7\,k_9\,k_{11} - 2\,k_2\,k_3\,k_4\,k_7\,k_8\,k_9\,k_{11} - 2\,k_2\,k_3\,k_4\,k_7\,k_8\,k_{11}^2$$
$$- 4\,k_2\,k_3\,k_4\,k_7\,k_9\,k_{11}^2 - 2\,k_2\,k_4\,k_5\,k_7\,k_8\,k_9\,k_{10} - k_2\,k_4\,k_5\,k_7\,k_8\,k_9\,k_{11}$$
$$- k_2\,k_4\,k_5\,k_7\,k_8\,k_{10}\,k_{11} - 2\,k_2\,k_4\,k_5\,k_7\,k_9\,k_{10}\,k_{11} - 2\,k_2\,k_4\,k_6\,k_7\,k_8\,k_9\,k_{10}$$
$$- k_2\,k_4\,k_6\,k_7\,k_8\,k_9\,k_{11} - k_2\,k_4\,k_6\,k_7\,k_8\,k_{10}\,k_{11} - 2\,k_2\,k_4\,k_6\,k_7\,k_9\,k_{10}\,k_{11}$$
$$- k_2\,k_4\,k_7\,k_8\,k_9\,k_{10}\,k_{11} - k_2\,k_4\,k_7\,k_8\,k_9\,k_{11}^2 - k_3^2\,k_4\,k_5\,k_7\,k_8\,k_9 - k_3^2\,k_4\,k_5\,k_7\,k_8\,k_{11} - 2$$
$$k_3^2\,k_4\,k_5\,k_7\,k_9\,k_{11} - k_3^2\,k_4\,k_6\,k_7\,k_8\,k_9 - k_3^2\,k_4\,k_6\,k_7\,k_8\,k_{11} - 2\,k_3^2\,k_4\,k_6\,k_7\,k_9\,k_{11} -$$
$$k_3^2\,k_4\,k_7\,k_8\,k_9\,k_{11} - k_3^2\,k_4\,k_7\,k_8\,k_{11}^2 - 2\,k_3^2\,k_4\,k_7\,k_9\,k_{11}^2 - 2\,k_3\,k_4\,k_5\,k_7\,k_8\,k_9\,k_{10}$$
$$- k_3\,k_4\,k_5\,k_7\,k_8\,k_9\,k_{11} - k_3\,k_4\,k_5\,k_7\,k_8\,k_{10}\,k_{11} - 2\,k_3\,k_4\,k_5\,k_7\,k_9\,k_{10}\,k_{11}$$
$$- 2\,k_3\,k_4\,k_6\,k_7\,k_8\,k_9\,k_{10} - k_3\,k_4\,k_6\,k_7\,k_8\,k_9\,k_{11} - k_3\,k_4\,k_6\,k_7\,k_8\,k_{10}\,k_{11}$$
$$- 2\,k_3\,k_4\,k_6\,k_7\,k_9\,k_{10}\,k_{11} - k_3\,k_4\,k_7\,k_8\,k_9\,k_{10}\,k_{11} - k_3\,k_4\,k_7\,k_8\,k_9\,k_{11}^2 - k_4\,k_5\,k_7\,k_8\,k_9\,k_{10}^2$$

$$- k_4 k_5 k_7 k_8 k_9 k_{10} k_{11} - k_4 k_6 k_7 k_8 k_9 k_{10}^2 - k_4 k_6 k_7 k_8 k_9 k_{10} k_{11} \Big) x_1 + \Big($$
$$-k_1 k_2 k_4 k_5 k_7 k_9 k_{10} - 2 k_1 k_2 k_4 k_5 k_7 k_9 k_{11} - k_1 k_2 k_4 k_5 k_7 k_{10} k_{11}$$
$$- k_1 k_2 k_4 k_6 k_7 k_9 k_{10} - 2 k_1 k_2 k_4 k_6 k_7 k_9 k_{11} - k_1 k_2 k_4 k_6 k_7 k_{10} k_{11}$$
$$- 2 k_1 k_2 k_4 k_7 k_9 k_{10} k_{11} - 2 k_1 k_2 k_4 k_7 k_9 k_{11}^2 - k_1 k_3 k_4 k_5 k_7 k_9 k_{10}$$
$$- 2 k_1 k_3 k_4 k_5 k_7 k_9 k_{11} - k_1 k_3 k_4 k_5 k_7 k_{10} k_{11} - k_1 k_3 k_4 k_6 k_7 k_9 k_{10}$$
$$- 2 k_1 k_3 k_4 k_6 k_7 k_9 k_{11} - k_1 k_3 k_4 k_6 k_7 k_{10} k_{11} - 2 k_1 k_3 k_4 k_7 k_9 k_{10} k_{11}$$
$$- 2 k_1 k_3 k_4 k_7 k_9 k_{11}^2 - k_1 k_4 k_5 k_7 k_9 k_{10}^2 - k_1 k_4 k_5 k_7 k_9 k_{10} k_{11} - k_1 k_4 k_6 k_7 k_9 k_{10}^2$$
$$- k_1 k_4 k_6 k_7 k_9 k_{10} k_{11} - k_2^2 k_4^2 k_7 k_8 k_{11} - k_2^2 k_4^2 k_7 k_{11}^2 - 2 k_2 k_3 k_4^2 k_7 k_8 k_{11} - 2 k_2 k_3$$
$$k_4^2 k_7 k_{11}^2 - k_2 k_4^2 k_7 k_8 k_{10} k_{11} - k_2 k_4^2 k_7 k_8 k_{11}^2 - k_3^2 k_4^2 k_7 k_8 k_{11} - k_3^2 k_4^2 k_7 k_{11}^2 - k_3$$
$$k_4^2 k_7 k_8 k_{10} k_{11} - k_3 k_4^2 k_7 k_8 k_{11}^2 \Big) x_1^2 + \Big(-k_1 k_2 k_4^2 k_7 k_{10} k_{11} - k_1 k_2 k_4^2 k_7 k_{11}^2 - k_1 k_3$$
$$k_4^2 k_7 k_{10} k_{11} - k_1 k_3 k_4^2 k_7 k_{11}^2 \Big) x_1^3 + \Big(-k_1 k_2 k_3 k_5^2 k_8 k_9 - k_1 k_2 k_3 k_5^2 k_9^2$$
$$- 2 k_1 k_2 k_3 k_5 k_6 k_8 k_9 - 2 k_1 k_2 k_3 k_5 k_6 k_9^2 - 2 k_1 k_2 k_3 k_5 k_8 k_9 k_{11} - 2 k_1 k_2 k_3 k_5$$
$$k_9^2 k_{11} - k_1 k_2 k_3 k_6^2 k_8 k_9 - k_1 k_2 k_3 k_6^2 k_9^2 - 2 k_1 k_2 k_3 k_6 k_8 k_9 k_{11} - 2 k_1 k_2 k_3 k_6 k_9^2 k_{11}$$
$$- k_1 k_2 k_3 k_8 k_9 k_{11}^2 - k_1 k_2 k_3 k_9^2 k_{11}^2 - k_1 k_2 k_5^2 k_7 k_8 k_9 - k_1 k_2 k_5^2 k_7 k_9^2$$
$$- 2 k_1 k_2 k_5 k_6 k_7 k_8 k_9 - 2 k_1 k_2 k_5 k_6 k_7 k_9^2 - k_1 k_2 k_5 k_6 k_8 k_9 k_{10} - k_1 k_2 k_5 k_6 k_9^2 k_{10}$$
$$- k_1 k_2 k_5 k_7 k_8 k_9 k_{10} - 2 k_1 k_2 k_5 k_7 k_8 k_9 k_{11} - k_1 k_2 k_5 k_7 k_9^2 k_{10} - 2 k_1 k_2 k_5 k_7 k_9^2 k_{11}$$
$$- k_1 k_2 k_6^2 k_7 k_8 k_9 - k_1 k_2 k_6^2 k_7 k_9^2 - k_1 k_2 k_6^2 k_8 k_9 k_{10} - k_1 k_2 k_6^2 k_9^2 k_{10}$$
$$- k_1 k_2 k_6 k_7 k_8 k_9 k_{10} - 2 k_1 k_2 k_6 k_7 k_8 k_9 k_{11} - k_1 k_2 k_6 k_7 k_9^2 k_{10} - 2 k_1 k_2 k_6 k_7 k_9^2 k_{11}$$
$$- k_1 k_2 k_6 k_8 k_9 k_{10} k_{11} - k_1 k_2 k_6 k_9^2 k_{10} k_{11} - k_1 k_2 k_7 k_8 k_9 k_{10} k_{11} - k_1 k_2 k_7 k_8 k_9 k_{11}^2$$
$$- k_1 k_2 k_7 k_9^2 k_{10} k_{11} - k_1 k_2 k_7 k_9^2 k_{11}^2 - k_1 k_3^2 k_5^2 k_8 k_9 - k_1 k_3^2 k_5^2 k_9^2 - 2 k_1 k_3^2 k_5 k_6 k_8 k_9$$
$$- 2 k_1 k_3^2 k_5 k_6 k_9^2 - 2 k_1 k_3^2 k_5 k_8 k_9 k_{11} - 2 k_1 k_3^2 k_5 k_9^2 k_{11} - k_1 k_3^2 k_6^2 k_8 k_9 - k_1 k_3^2 k_6^2 k_9^2$$
$$- 2 k_1 k_3^2 k_6 k_8 k_9 k_{11} - 2 k_1 k_3^2 k_6 k_9^2 k_{11} - k_1 k_3^2 k_8 k_9 k_{11}^2 - k_1 k_3^2 k_9^2 k_{11}^2 - k_1 k_3$$
$$k_5^2 k_7 k_8 k_9 - k_1 k_3 k_5^2 k_7 k_9^2 - k_1 k_3 k_5^2 k_8 k_9 k_{10} - k_1 k_3 k_5^2 k_9^2 k_{10} - 2 k_1 k_3 k_5 k_6 k_7 k_8 k_9$$
$$- 2 k_1 k_3 k_5 k_6 k_7 k_9^2 - 3 k_1 k_3 k_5 k_6 k_8 k_9 k_{10} - 3 k_1 k_3 k_5 k_6 k_9^2 k_{10}$$
$$- k_1 k_3 k_5 k_7 k_8 k_9 k_{10} - 2 k_1 k_3 k_5 k_7 k_8 k_9 k_{11} - k_1 k_3 k_5 k_7 k_9^2 k_{10} - 2 k_1 k_3 k_5 k_7 k_9^2 k_{11}$$
$$- k_1 k_3 k_5 k_8 k_9 k_{10} k_{11} - k_1 k_3 k_5 k_9^2 k_{10} k_{11} - k_1 k_3 k_6^2 k_7 k_8 k_9 - k_1 k_3 k_6^2 k_7 k_9^2$$
$$- 2 k_1 k_3 k_6^2 k_8 k_9 k_{10} - 2 k_1 k_3 k_6^2 k_9^2 k_{10} - k_1 k_3 k_6 k_7 k_8 k_9 k_{10} - 2 k_1 k_3 k_6 k_7 k_8 k_9 k_{11}$$

$$- k_1 k_3 k_6 k_7 k_9^2 k_{10} - 2 k_1 k_3 k_6 k_7 k_9^2 k_{11} - 2 k_1 k_3 k_6 k_8 k_9 k_{10} k_{11} - 2 k_1 k_3 k_6$$
$$k_9^2 k_{10} k_{11} - k_1 k_3 k_7 k_8 k_9 k_{10} k_{11} - k_1 k_3 k_7 k_8 k_9 k_{11}^2 - k_1 k_3 k_7 k_9^2 k_{10} k_{11} - k_1 k_3 k_7 k_9^2$$
$$k_{11}^2 - k_1 k_5^2 k_7 k_8 k_9 k_{10} - k_1 k_5^2 k_7 k_9^2 k_{10} - 2 k_1 k_5 k_6 k_7 k_8 k_9 k_{10} - 2 k_1 k_5 k_6 k_7 k_9^2 k_{10}$$
$$- k_1 k_5 k_6 k_8 k_9 k_{10}^2 - k_1 k_5 k_6 k_9^2 k_{10}^2 - k_1 k_5 k_7 k_8 k_9 k_{10}^2 - k_1 k_5 k_7 k_8 k_9 k_{10} k_{11}$$
$$- k_1 k_5 k_7 k_9^2 k_{10}^2 - k_1 k_5 k_7 k_9^2 k_{10} k_{11} - k_1 k_6^2 k_7 k_8 k_9 k_{10} - k_1 k_6^2 k_7 k_9^2 k_{10} - k_1$$
$$k_6^2 k_8 k_9 k_{10}^2 - k_1 k_6^2 k_9^2 k_{10}^2 - k_1 k_6 k_7 k_8 k_9 k_{10}^2 - k_1 k_6 k_7 k_8 k_9 k_{10} k_{11} - k_1 k_6 k_7 k_9^2 k_{10}^2$$
$$- k_1 k_6 k_7 k_9^2 k_{10} k_{11} - k_2^2 k_4 k_5 k_6 k_8^2 - k_2^2 k_4 k_5 k_6 k_8 k_9 - k_2^2 k_4 k_5 k_7 k_8^2 -$$
$$k_2^2 k_4 k_5 k_7 k_8 k_9 - k_2^2 k_4 k_6^2 k_8^2 - k_2^2 k_4 k_6^2 k_8 k_9 - k_2^2 k_4 k_6 k_7 k_8^2 - k_2^2 k_4 k_6 k_7 k_8 k_9 -$$
$$k_2^2 k_4 k_6 k_8^2 k_{11} - k_2^2 k_4 k_6 k_8 k_9 k_{11} - k_2^2 k_4 k_7 k_8^2 k_{11} - k_2^2 k_4 k_7 k_8 k_9 k_{11}$$
$$- 2 k_2 k_3 k_4 k_5 k_6 k_8^2 - 2 k_2 k_3 k_4 k_5 k_6 k_8 k_9 - 2 k_2 k_3 k_4 k_5 k_7 k_8^2 - 2 k_2 k_3 k_4 k_5 k_7 k_8 k_9$$
$$- k_2 k_3 k_4 k_5 k_8^2 k_{11} - k_2 k_3 k_4 k_5 k_8 k_9 k_{11} - 2 k_2 k_3 k_4 k_6^2 k_8^2 - 2 k_2 k_3 k_4 k_6^2 k_8 k_9$$
$$- 2 k_2 k_3 k_4 k_6 k_7 k_8^2 - 2 k_2 k_3 k_4 k_6 k_7 k_8 k_9 - 3 k_2 k_3 k_4 k_6 k_8^2 k_{11}$$
$$- 3 k_2 k_3 k_4 k_6 k_8 k_9 k_{11} - 2 k_2 k_3 k_4 k_7 k_8^2 k_{11} - 2 k_2 k_3 k_4 k_7 k_8 k_9 k_{11} - k_2 k_3 k_4 k_8^2 k_{11}^2$$
$$- k_2 k_3 k_4 k_8 k_9 k_{11}^2 - 2 k_2 k_4 k_5 k_6 k_8^2 k_{10} - 2 k_2 k_4 k_5 k_6 k_8 k_9 k_{10} - 2 k_2 k_4 k_5 k_7 k_8^2 k_{10}$$
$$- k_2 k_4 k_5 k_7 k_8^2 k_{11} - 2 k_2 k_4 k_5 k_7 k_8 k_9 k_{10} - k_2 k_4 k_5 k_7 k_8 k_9 k_{11} - 2 k_2 k_4 k_6^2 k_8^2 k_{10}$$
$$- 2 k_2 k_4 k_6^2 k_8 k_9 k_{10} - 2 k_2 k_4 k_6 k_7 k_8^2 k_{10} - k_2 k_4 k_6 k_7 k_8^2 k_{11} - 2 k_2 k_4 k_6 k_7 k_8 k_9 k_{10}$$
$$- k_2 k_4 k_6 k_7 k_8 k_9 k_{11} - k_2 k_4 k_6 k_8^2 k_{10} k_{11} - k_2 k_4 k_6 k_8 k_9 k_{10} k_{11} - k_2 k_4 k_7 k_8^2 k_{10} k_{11}$$
$$- k_2 k_4 k_7 k_8^2 k_{11}^2 - k_2 k_4 k_7 k_8 k_9 k_{10} k_{11} - k_2 k_4 k_7 k_8 k_9 k_{11}^2 - k_3^2 k_4 k_5 k_6 k_8^2 -$$
$$k_3^2 k_4 k_5 k_6 k_8 k_9 - k_3^2 k_4 k_5 k_7 k_8^2 - k_3^2 k_4 k_5 k_7 k_8 k_9 - k_3^2 k_4 k_5 k_8^2 k_{11} - k_3^2 k_4 k_5 k_8 k_9 k_{11}$$
$$- k_3^2 k_4 k_6^2 k_8^2 - k_3^2 k_4 k_6^2 k_8 k_9 - k_3^2 k_4 k_6 k_7 k_8^2 - k_3^2 k_4 k_6 k_7 k_8 k_9 - 2 k_3^2 k_4 k_6 k_8^2 k_{11} - 2$$
$$k_3^2 k_4 k_6 k_8 k_9 k_{11} - k_3^2 k_4 k_7 k_8^2 k_{11} - k_3^2 k_4 k_7 k_8 k_9 k_{11} - k_3^2 k_4 k_8^2 k_{11}^2 - k_3^2 k_4 k_8 k_9 k_{11}^2$$
$$- 2 k_3 k_4 k_5 k_6 k_8^2 k_{10} - 2 k_3 k_4 k_5 k_6 k_8 k_9 k_{10} - 2 k_3 k_4 k_5 k_7 k_8^2 k_{10} - k_3 k_4 k_5 k_7 k_8^2 k_{11}$$
$$- 2 k_3 k_4 k_5 k_7 k_8 k_9 k_{10} - k_3 k_4 k_5 k_7 k_8 k_9 k_{11} - k_3 k_4 k_5 k_8^2 k_{10} k_{11}$$
$$- k_3 k_4 k_5 k_8 k_9 k_{10} k_{11} - 2 k_3 k_4 k_6^2 k_8^2 k_{10} - 2 k_3 k_4 k_6^2 k_8 k_9 k_{10} - 2 k_3 k_4 k_6 k_7 k_8^2 k_{10}$$
$$- k_3 k_4 k_6 k_7 k_8^2 k_{11} - 2 k_3 k_4 k_6 k_7 k_8 k_9 k_{10} - k_3 k_4 k_6 k_7 k_8 k_9 k_{11} - 2 k_3 k_4 k_6$$
$$k_8^2 k_{10} k_{11} - 2 k_3 k_4 k_6 k_8 k_9 k_{10} k_{11} - k_3 k_4 k_7 k_8^2 k_{10} k_{11} - k_3 k_4 k_7 k_8^2 k_{11}^2$$
$$- k_3 k_4 k_7 k_8 k_9 k_{10} k_{11} - k_3 k_4 k_7 k_8 k_9 k_{11}^2 - k_4 k_5 k_6 k_8^2 k_{10}^2 - k_4 k_5 k_6 k_8 k_9 k_{10}^2$$

$$- k_4 k_5 k_7 k_8^2 k_{10}^2 - k_4 k_5 k_7 k_8^2 k_{10} k_{11} - k_4 k_5 k_7 k_8 k_9 k_{10}^2 - k_4 k_5 k_7 k_8 k_9 k_{10} k_{11} - k_4$$
$$k_6^2 k_8^2 k_{10}^2 - k_4 k_6^2 k_8 k_9 k_{10}^2 - k_4 k_6 k_7 k_8^2 k_{10}^2 - k_4 k_6 k_7 k_8^2 k_{10} k_{11} - k_4 k_6 k_7 k_8 k_9 k_{10}^2$$
$$- k_4 k_6 k_7 k_8 k_9 k_{10} k_{11} \big) x_3 - k_2^2 k_5^2 k_7 k_8 k_9 - 2 k_2^2 k_5 k_6 k_7 k_9^2 - 2 k_2^2 k_5 k_7 k_9^2 k_{11} - k_2^2$$
$$k_6^2 k_7 k_8 k_9 - 2 k_2^2 k_6 k_7 k_9^2 k_{11} - k_2^2 k_7 k_8 k_9 k_{11}^2 - 2 k_2 k_3 k_5^2 k_7 k_9^2 - 2 k_2 k_3 k_6^2 k_7 k_9^2$$
$$- 2 k_2 k_3 k_7 k_9^2 k_{11}^2 - 2 k_2 k_5^2 k_7 k_9^2 k_{10} - 2 k_2 k_6^2 k_7 k_9^2 k_{10} - k_3^2 k_5^2 k_7 k_8 k_9 - 2$$
$$k_3^2 k_5 k_6 k_7 k_9^2 - 2 k_3^2 k_5 k_7 k_9^2 k_{11} - k_3^2 k_6^2 k_7 k_8 k_9 - 2 k_3^2 k_6 k_7 k_9^2 k_{11} - k_3^2 k_7 k_8 k_9 k_{11}^2$$
$$- 2 k_3 k_5^2 k_7 k_9^2 k_{10} - 2 k_3 k_6^2 k_7 k_9^2 k_{10} - k_5^2 k_7 k_8 k_9 k_{10}^2 - 2 k_5 k_6 k_7 k_9^2 k_{10}^2 - k_6^2 k_7 k_8 k_9$$
$$k_{10}^2 + \big(k_1^2 k_3 k_4 k_5 k_9 k_{10} - k_1^2 k_3 k_4 k_5 k_{10} k_{11} + k_1^2 k_3 k_4 k_6 k_9 k_{10} - k_1^2 k_3 k_4 k_6 k_{10} k_{11}$$
$$- k_1^2 k_4 k_5 k_6 k_9 k_{10} - k_1^2 k_4 k_5 k_6 k_{10}^2 - k_1^2 k_4 k_5 k_7 k_{10}^2 - k_1^2 k_4 k_5 k_7 k_{10} k_{11} - k_1^2 k_4$$
$$k_6^2 k_9 k_{10} - k_1^2 k_4 k_6^2 k_{10}^2 - k_1^2 k_4 k_6 k_7 k_{10}^2 - k_1^2 k_4 k_6 k_7 k_{10} k_{11} - k_1 k_2 k_3 k_4^2 k_8 k_{11}$$
$$- k_1 k_2 k_3 k_4^2 k_{11}^2 + k_1 k_2 k_4^2 k_6 k_8 k_{11} - k_1 k_2 k_4^2 k_6 k_{10} k_{11} - k_1 k_2 k_4^2 k_7 k_{10} k_{11} - k_1 k_2$$
$$k_4^2 k_7 k_{11}^2 - k_1 k_3^2 k_4^2 k_8 k_{11} - k_1 k_3^2 k_4^2 k_{11}^2 + k_1 k_3 k_4^2 k_6 k_8 k_{11} - k_1 k_3 k_4^2 k_6 k_{10} k_{11}$$
$$- k_1 k_3 k_4^2 k_7 k_{10} k_{11} - k_1 k_3 k_4^2 k_7 k_{11}^2 \big) x_1^2 x_3 + \big(-2 k_1 k_2 k_3 k_4 k_5 k_8 k_{11}$$
$$- 2 k_1 k_2 k_3 k_4 k_5 k_9 k_{11} - 2 k_1 k_2 k_3 k_4 k_6 k_8 k_{11} - 2 k_1 k_2 k_3 k_4 k_6 k_9 k_{11}$$
$$- 2 k_1 k_2 k_3 k_4 k_8 k_{11}^2 - 2 k_1 k_2 k_3 k_4 k_9 k_{11}^2 - 2 k_1 k_2 k_4 k_5 k_6 k_8 k_{10}$$
$$- 2 k_1 k_2 k_4 k_5 k_6 k_9 k_{10} - 2 k_1 k_2 k_4 k_5 k_7 k_8 k_{10} - 2 k_1 k_2 k_4 k_5 k_7 k_8 k_{11}$$
$$- 2 k_1 k_2 k_4 k_5 k_7 k_9 k_{10} - 2 k_1 k_2 k_4 k_5 k_7 k_9 k_{11} - 2 k_1 k_2 k_4 k_6^2 k_8 k_{10} - 2 k_1 k_2 k_4$$
$$k_6^2 k_9 k_{10} - 2 k_1 k_2 k_4 k_6 k_7 k_8 k_{10} - 2 k_1 k_2 k_4 k_6 k_7 k_8 k_{11} - 2 k_1 k_2 k_4 k_6 k_7 k_9 k_{10}$$
$$- 2 k_1 k_2 k_4 k_6 k_7 k_9 k_{11} - 2 k_1 k_2 k_4 k_6 k_8 k_{10} k_{11} - 2 k_1 k_2 k_4 k_6 k_9 k_{10} k_{11}$$
$$- 2 k_1 k_2 k_4 k_7 k_8 k_{10} k_{11} - 2 k_1 k_2 k_4 k_7 k_8 k_{11}^2 - 2 k_1 k_2 k_4 k_7 k_9 k_{10} k_{11}$$
$$- 2 k_1 k_2 k_4 k_7 k_9 k_{11}^2 - 2 k_1 k_3^2 k_4 k_5 k_8 k_{11} - 2 k_1 k_3^2 k_4 k_5 k_9 k_{11} - 2 k_1 k_3^2 k_4 k_6 k_8 k_{11}$$
$$- 2 k_1 k_3^2 k_4 k_6 k_9 k_{11} - 2 k_1 k_3^2 k_4 k_8 k_{11}^2 - 2 k_1 k_3^2 k_4 k_9 k_{11}^2 - 2 k_1 k_3 k_4 k_5 k_6 k_8 k_{10}$$
$$- 2 k_1 k_3 k_4 k_5 k_6 k_9 k_{10} - 2 k_1 k_3 k_4 k_5 k_7 k_8 k_{10} - 2 k_1 k_3 k_4 k_5 k_7 k_8 k_{11}$$
$$- 2 k_1 k_3 k_4 k_5 k_7 k_9 k_{10} - 2 k_1 k_3 k_4 k_5 k_7 k_9 k_{11} - 2 k_1 k_3 k_4 k_5 k_8 k_{10} k_{11}$$
$$- 2 k_1 k_3 k_4 k_5 k_9 k_{10} k_{11} - 2 k_1 k_3 k_4 k_6^2 k_8 k_{10} - 2 k_1 k_3 k_4 k_6^2 k_9 k_{10}$$
$$- 2 k_1 k_3 k_4 k_6 k_7 k_8 k_{10} - 2 k_1 k_3 k_4 k_6 k_7 k_8 k_{11} - 2 k_1 k_3 k_4 k_6 k_7 k_9 k_{10}$$
$$- 2 k_1 k_3 k_4 k_6 k_7 k_9 k_{11} - 4 k_1 k_3 k_4 k_6 k_8 k_{10} k_{11} - 4 k_1 k_3 k_4 k_6 k_9 k_{10} k_{11}$$

$- 2 k_1 k_3 k_4 k_7 k_8 k_{10} k_{11} - 2 k_1 k_3 k_4 k_7 k_8 k_{11}^2 - 2 k_1 k_3 k_4 k_7 k_9 k_{10} k_{11}$
$- 2 k_1 k_3 k_4 k_7 k_9 k_{11}^2 - 2 k_1 k_4 k_5 k_6 k_8 k_{10}^2 - 2 k_1 k_4 k_5 k_6 k_9 k_{10}^2 - 2 k_1 k_4 k_5 k_7 k_8 k_{10}^2$
$- 2 k_1 k_4 k_5 k_7 k_8 k_{10} k_{11} - 2 k_1 k_4 k_5 k_7 k_9 k_{10}^2 - 2 k_1 k_4 k_5 k_7 k_9 k_{10} k_{11} - 2 k_1 k_4 k_6^2 k_8$
$k_{10}^2 - 2 k_1 k_4 k_6^2 k_9 k_{10}^2 - 2 k_1 k_4 k_6 k_7 k_8 k_{10}^2 - 2 k_1 k_4 k_6 k_7 k_8 k_{10} k_{11} - 2 k_1 k_4 k_6 k_7 k_9$
$k_{10}^2 - 2 k_1 k_4 k_6 k_7 k_9 k_{10} k_{11} \big) x_1 x_3 - k_2^2 k_5^2 k_7 k_9^2 - k_2^2 k_6^2 k_7 k_9^2 - k_2^2 k_7 k_9^2 k_{11}^2 - k_3^2 k_5^2 k_7$
$k_9^2 - k_3^2 k_6^2 k_7 k_9^2 - k_3^2 k_7 k_9^2 k_{11}^2 - k_5^2 k_7 k_9^2 k_{10}^2 - k_6^2 k_7 k_9^2 k_{10}^2$

>

> $term := \big(k_1^2 k_3 k_4 k_5 k_9 k_{10} - k_1^2 k_3 k_4 k_5 k_{10} k_{11} + k_1^2 k_3 k_4 k_6 k_9 k_{10} - k_1^2 k_3 k_4 k_6 k_{10} k_{11} -$
$k_1^2 k_4 k_5 k_6 k_9 k_{10} - k_1^2 k_4 k_5 k_6 k_{10}^2 - k_1^2 k_4 k_5 k_7 k_{10}^2 - k_1^2 k_4 k_5 k_7 k_{10} k_{11} - k_1^2 k_4 k_6^2 k_9 k_{10}$
$- k_1^2 k_4 k_6^2 k_{10}^2 - k_1^2 k_4 k_6 k_7 k_{10}^2 - k_1^2 k_4 k_6 k_7 k_{10} k_{11} - k_1 k_2 k_3 k_4^2 k_8 k_{11} - k_1 k_2 k_3 k_4^2 k_{11}^2$
$+ k_1 k_2 k_4^2 k_6 k_8 k_{11} - k_1 k_2 k_4^2 k_6 k_{10} k_{11} - k_1 k_2 k_4^2 k_7 k_{10} k_{11} - k_1 k_2 k_4^2 k_7 k_{11}^2 - k_1 k_3^2$
$k_4^2 k_8 k_{11} - k_1 k_3^2 k_4^2 k_{11}^2 + k_1 k_3 k_4^2 k_6 k_8 k_{11} - k_1 k_3 k_4^2 k_6 k_{10} k_{11} - k_1 k_3 k_4^2 k_7 k_{10} k_{11}$
$- k_1 k_3 k_4^2 k_7 k_{11}^2 \big) :$

>

Here, we get again the same coefficient as the allosteric model, because if we allow different reaction constants (which in turn is equivalent to different free energy of bound state of K) is actually indicating there is allosteric regulation on K (by binding to scaffold protein).