CBEM PROJECT 2

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Project 2: Regression Analysis

- example is the model 1 $k_f = g(\boldsymbol{x}, T, \varphi, \dot{\varphi}) = x_6 \cdot e^{x_1 \cdot T} \cdot \dot{\varphi}^{x_2 + x_5 \cdot T} \cdot \varphi^{x_3} \cdot e^{x_4 \cdot \varphi}$.
- example is the model 2 $k_f = x_{10} \cdot e^{x_1 \cdot T} \cdot \dot{\varphi}^{x_2 + x_5 \cdot T + x_6 \cdot \varphi} \cdot \varphi^{x_3 + x_7 \cdot T + x_8 \cdot \dot{\varphi}} \cdot e^{x_4 \cdot \varphi + x_9 \cdot \dot{\varphi}}$.

Source of the data

- Three data sheets from moodle.
  - C15
  - C60
  - 100Cr6
- Each will have different R-square values.
- The values and graphs used below are from the Dataset -100Cr6

Model 1

$$k_f = g(\boldsymbol{x}, T, \varphi, \dot{\varphi}) = x_6 \cdot e^{x_1 \cdot T} \cdot \dot{\varphi}^{x_2 + x_5 \cdot T} \cdot \varphi^{x_3} \cdot e^{x_4 \cdot \varphi}$$

```
function [kf_calc,opt_x]=model1(filename);
filename = 'Cr6.mat';
dataset = importdata(filename);

%Loading Data from Dataset to variables
phidot=dataset(:,1);
phi=dataset(:,2);
Temp=dataset(:,3);
kf_data=dataset(:,4);

%Assigning the parameters
B=log(kf_data);
t1=Temp;
t2=log(phidot);
t3=log(phi);
t4=phi;
t5=Temp.*log(phidot);
t6=ones(size(dataset,1),1);

%Putting the parameters in the array
A=[t1 t2 t3 t4 t5 t6];


%Ax=B
%x = A\B
opt_x=A\B;

mod1_x1=opt_x(1,1);
mod1_x2=opt_x(2,1);
mod1_x3=opt_x(3,1);
mod1_x4=opt_x(4,1);
mod1_x5=opt_x(5,1);
mod1_x6=exp(opt_x(6,1));

%Our prediction of Kf
kf_calc=exp(A*opt_x);
opt_x
mod1_x6
disp('R_square of model(1)');
rsquare(kf_data,kf_calc)
```

Calculated values from model 1

- R-square = 0.8648
- Ax=B
- Compute x = A\B
- x is a 6x1 matrix
- x =

  -0.0013
  0.0623
  0.1520
  -0.1681
  -0.0001
  1275.3

Model 2

$$k_f = x_{10} \cdot e^{x_1 \cdot T} \cdot \dot{\varphi}^{x_2 + x_5 \cdot T + x_6 \cdot \varphi} \cdot \varphi^{x_3 + x_7 \cdot T + x_8 \cdot \dot{\varphi}} \cdot e^{x_4 \cdot \varphi + x_9 \cdot \dot{\varphi}}$$

Calculated values from model 2

```
function [kf_calc,opt_x]=model2(filename);
filename = 'Cr6.mat';
dataset = importdata(filename);

phidot=dataset(:,1);
phi=dataset(:,2);
Temp=dataset(:,3);
kf_data=dataset(:,4);

B=log(kf_data);
t1=Temp;
t2=log(phidot);
t3=log(phi);
t4=phi;
t5=Temp.*log(phidot);
t6=phi.*log(phidot);
t7=Temp.*log(phi);
t8=phidot.*log(phi);
t9=phidot;
t10=ones(size(dataset,1),1);

A=[t1 t2 t3 t4 t5 t6 t7 t8 t9 t10];

%Ax=B
%x = A\B
opt_x = A\B;

mod2_x1 = opt_x(1,1);
mod2_x2 = opt_x(2,1);
mod2_x3 = opt_x(3,1);
mod2_x4 = opt_x(4,1);
mod2_x5 = opt_x(5,1);
mod2_x6 = opt_x(6,1);
mod2_x7 = opt_x(7,1);
mod2_x8 = opt_x(8,1);
mod2_x9 = opt_x(9,1);
mod2_x10 = exp(opt_x(10,1));

kf_calc=exp(A*opt_x);
opt_x
mod2_x10
display('R_square of model(2)');
rsquare(kf_data,kf_calc)
```

- R-square = 0.9385
- Calculation same as in the model 1
- x is a 10x1 matrix
- x=

-0.0016

0.0820

0.2586

-0.0297

-0.0001

-0.0521

-0.0003

0.0008

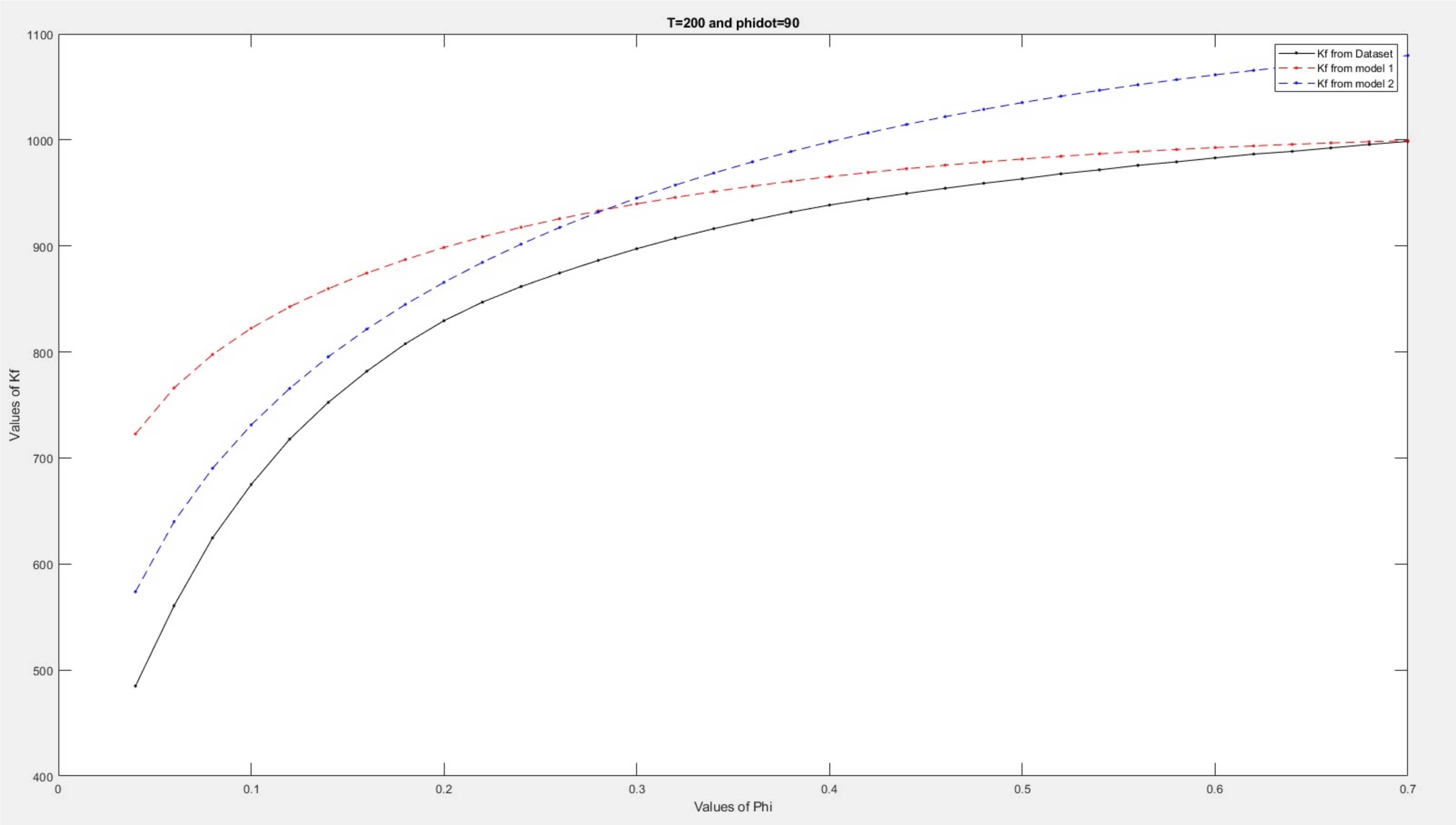
0.0010

R-squared

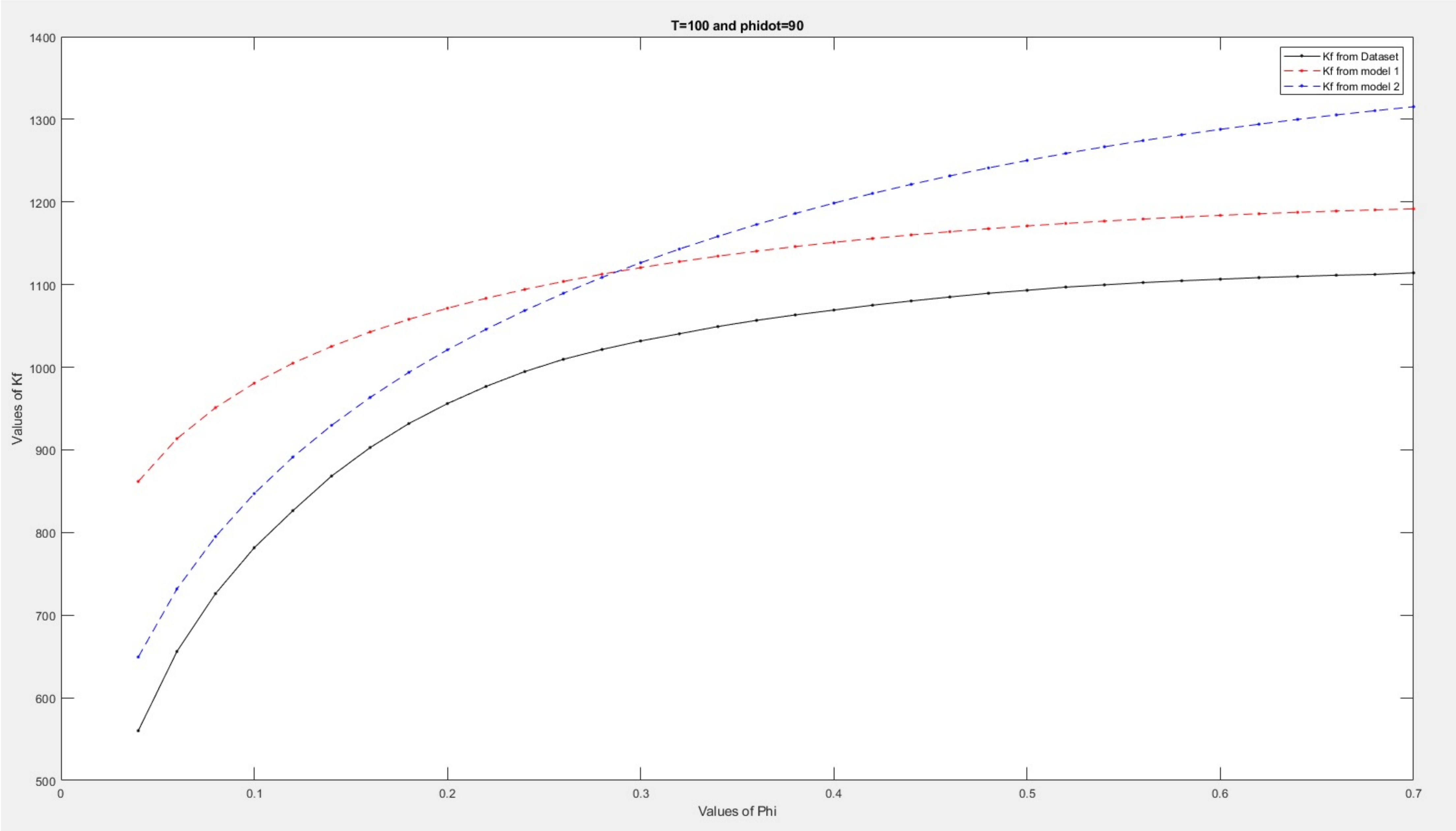
- the coefficient of determination for models 1 is R-squared= 0.8648
- the coefficient of determination for models 2 is R-squared= 0.9385

2 Dimensional graphs

We choose Temp and Phidot to be constant because they are the variables that change the least amount of times throughout the datasets.



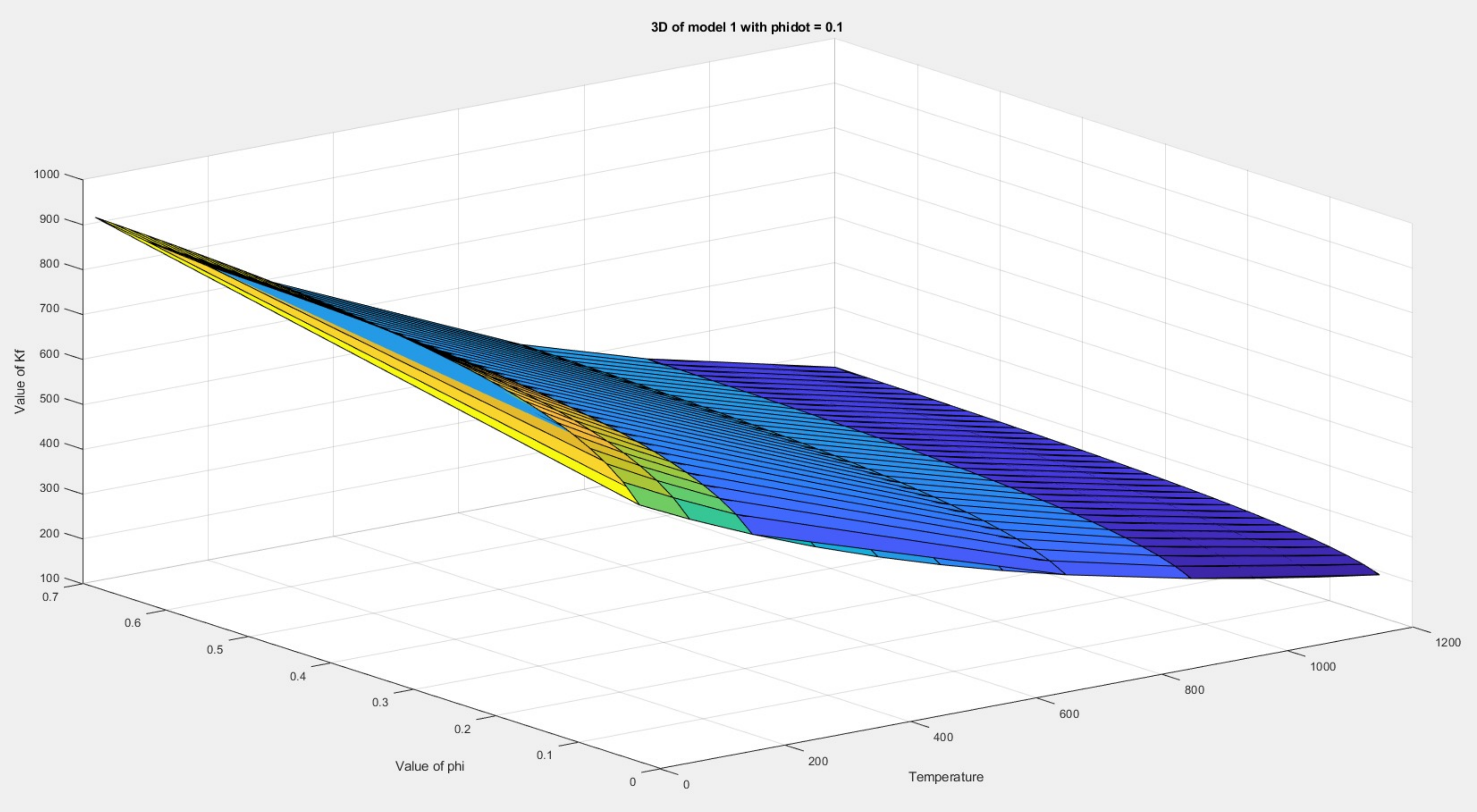
T=200 and phidot=90
Kf from Dataset
Kf from model 1
Kf from model 2
Values of Kf
Values of Phi

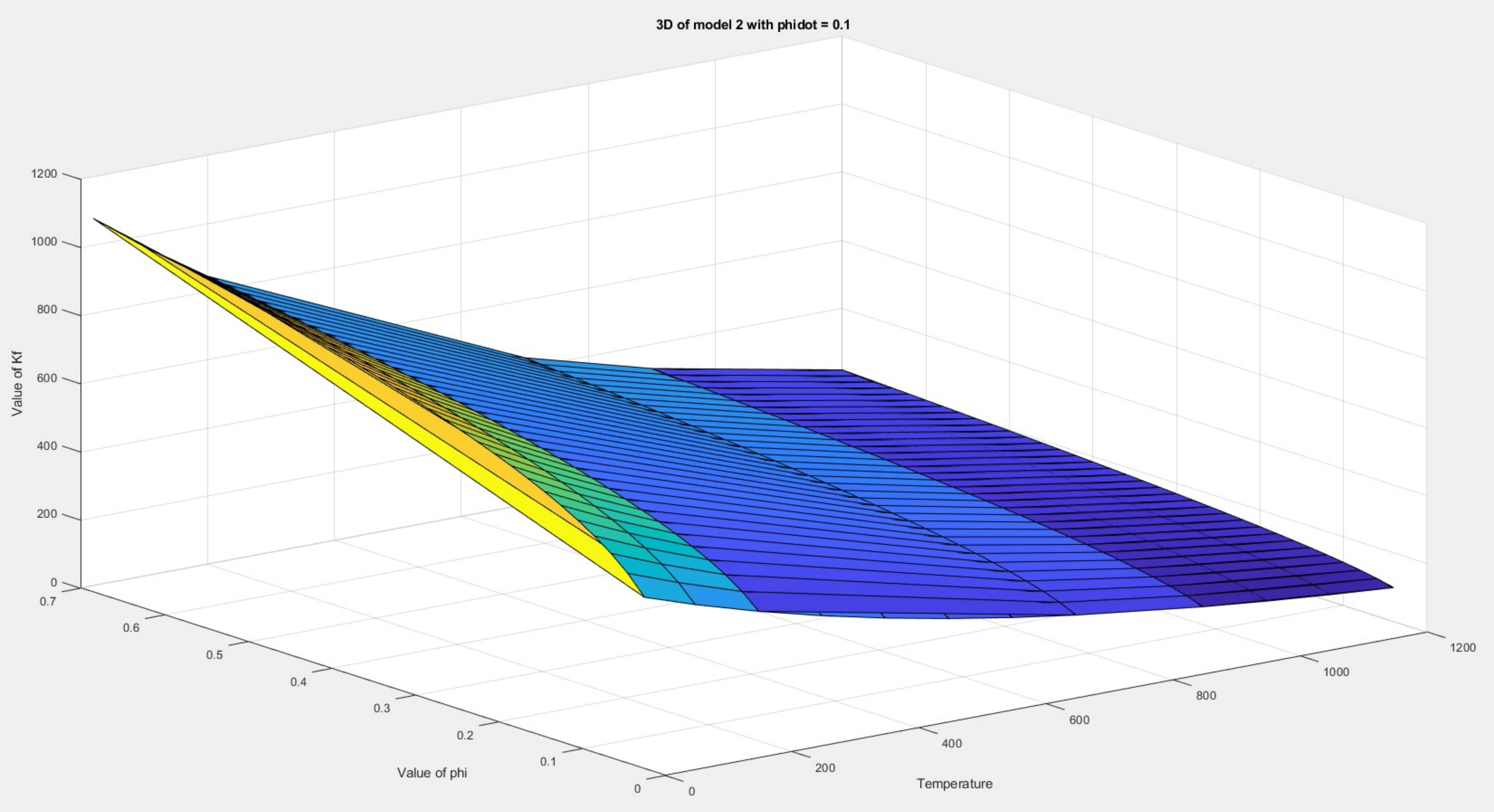


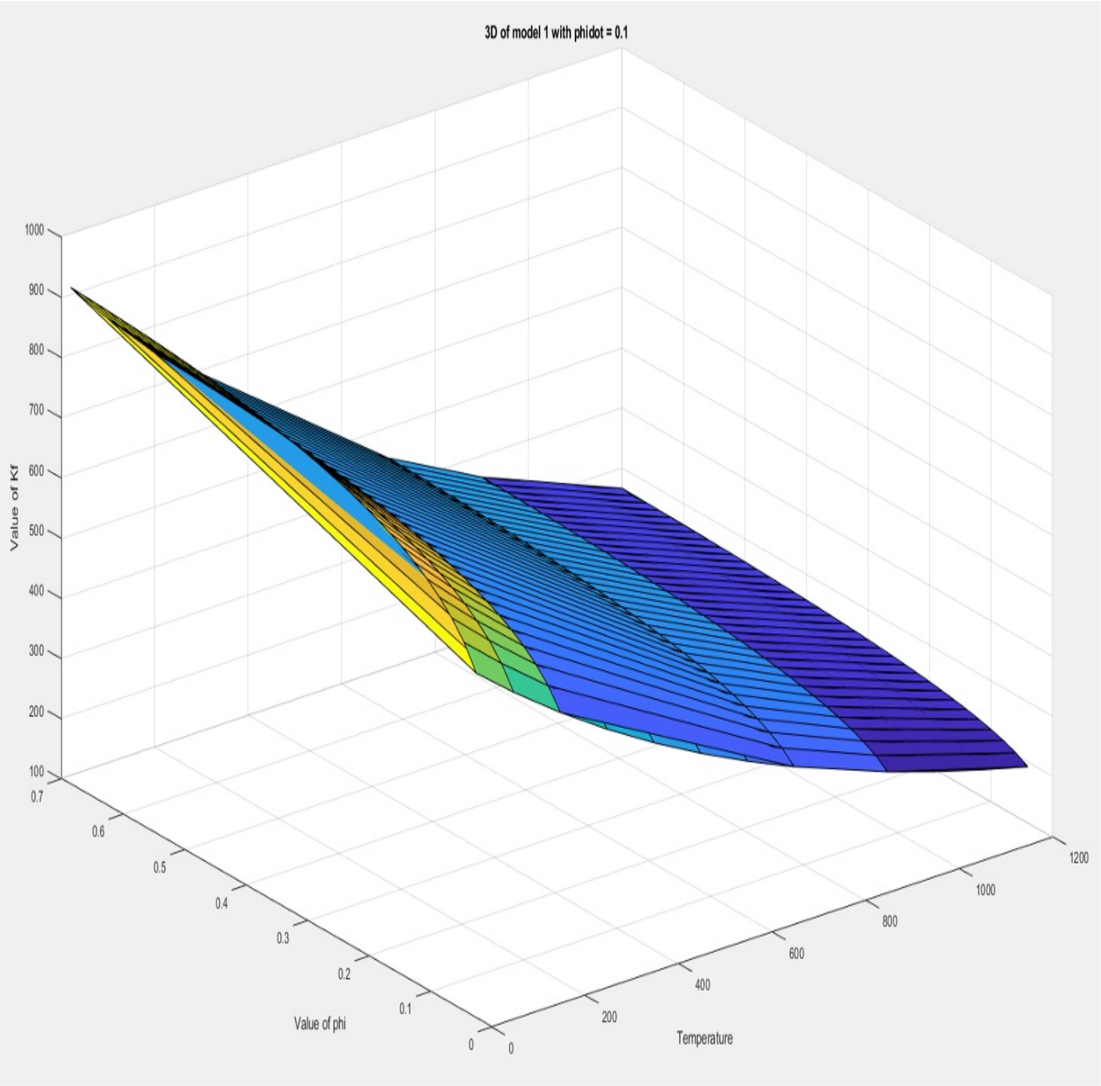
T=100 and phidot=90
Kf from Dataset
Kf from model 1
Kf from model 2
Values of Kf
Values of Phi
1400
1300
1200
1100
1000
900
800
700
600
500
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

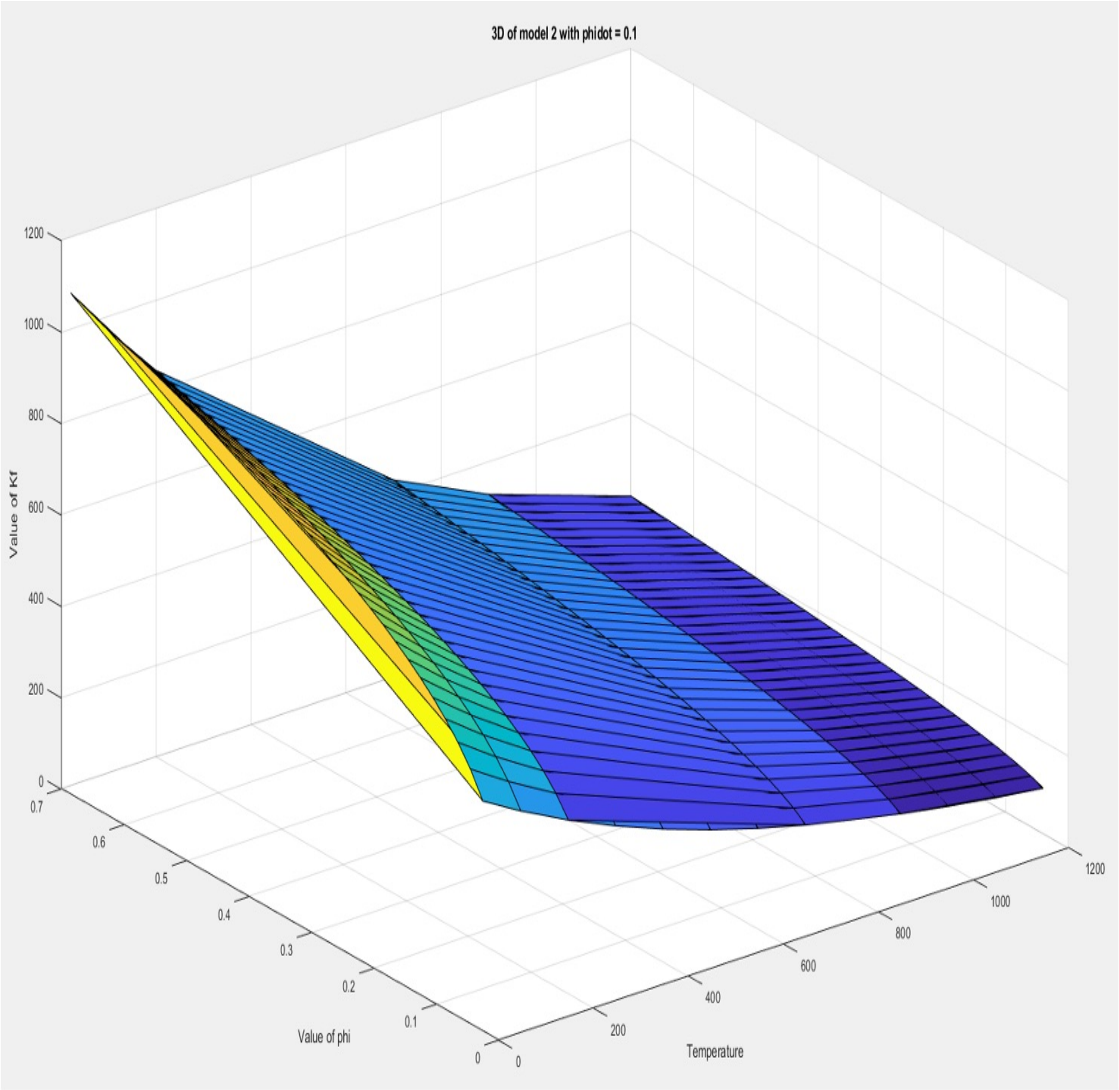
3 Dimensional graphs

For the 3 dimensional graphs we choose Phidot to be constant as it changes even less than Temp throughout the datasets


3D of model 1 with phidot = 0.1
Value of Kf
1000
900
800
700
600
500
400
300
200
100
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Value of phi
0
200
400
600
800
1000
1200
Temperature


3D of model 2 with phidot = 0.1
Value of Kf
1200
1000
800
600
400
200
0
Value of phi
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Temperature
0
200
400
600
800
1000
1200


3D of model 1 with phidot = 0.1
Value of Kf
1000
900
800
700
600
500
400
300
200
100
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Value of phi
0
200
400
600
800
1000
1200
Temperature


3D of model 2 with phidot = 0.1
Value of Kf
1200
1000
800
600
400
200
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Value of phi
0
200
400
600
800
1000
1200
Temperature

Comparison conclusion

We can conclude that values predicted by model 2 are closer to the kf values from the dataset at the lower values of phi but as phi increases model 1 becomes closer and closer to the kf value from the dataset

Thank you very much