Parameter Uncertainty probability density function (p.d.f)

The uncertainty p.d.f describes the relative probability of the parameters that will fall within a certain range. It requires the assumptions as to p.d.f of the input parameters

To assume the ranges of each parameters we initialize the ranges from Parameter value+0.05 to parameter value-0.05 for both the parameters.

We can calculate the probabiltity density function as p(thetahat|D) =

Exp(-1/2(theta – thetahat)T summation (theta – thetahat)) / ✓ ((2 \* pi )n|sigma |)

Where n Is the dimension of theta

For calculationg the 3D plot of p.d.f

no\_points = 20 #determining the length of the matrixes

number\_of\_parameters = 2

theta\_1\_range = seq(thetaHat\_final[1]-0.005 , thetaHat\_final[1]+0.005 , length=no\_points) #range of parameter1

theta\_2\_range = seq(thetaHat\_final[2]-0.005 , thetaHat\_final[2]+0.005 , length=no\_points)

#range of parameter 2

# initialixing a probability density function matrix for saving the values

p\_thetaHat\_D = matrix(0 , no\_points , no\_points)

for(r in 1:20){

for(c in 1:20){

theta\_12 = matrix( c( theta\_1\_range[r] , theta\_2\_range[c] ) , number\_of\_parameters , 1)

thetaHat\_theta = theta\_12 - thetaHat\_final

p\_thetaHat\_D[r,c] = ( 1/sqrt( ( (2\*pi)^number\_of\_parameters ) \* det\_cov\_thetaHat) ) \* exp( -0.5 \* t(-thetaHat\_theta) %\*% cov\_thetaHat\_inv %\*% -thetaHat\_theta )

}

}

Now for plotting the 3D p.d.f graph using the persp() function:

persp(theta\_1\_range, theta\_2\_range, p\_thetaHat\_D , theta = 20 , phi = 60) # theta changes the rotation (left-right), phi changes the rotation (up-down)

Contour Plot:

Contour plot is a way of plotting the 3D graph in 2-dimensional plane. This can be done by plotting X and Y values on Y-axis to the Z values on the X-axis .

It gives the relation ship between the the 2 paramenter values with respect to the p.d.f

The contour plot is given as :

contour(theta\_1\_range, theta\_2\_range, p\_thetaHat\_D) # x and y values are the ranges assumed for the parameters and Z value is the p.d.f

Model output and prediction on training data.:

The prediction are calculated as:

Yhat = X\*thetahat

y\_hat\_pred\_train = final\_X %\*% thetaHat\_final

Similarly after splitting the data into 70:30 then the esitimated graph is guven as:

A close up of a map

Description automatically generated

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