

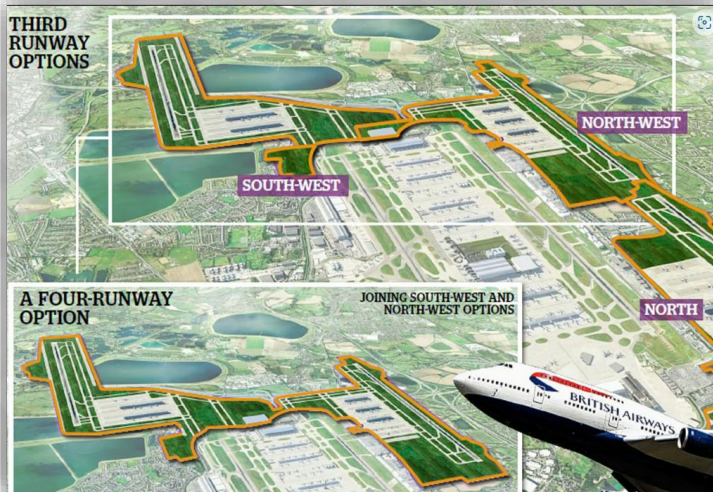
1.3: Optimization in Relation to Problem-Solving

Investigate at least three different weather stations and three different years and find values where the gradient descent converges

For this Exercise:

1. I chose a warm (Madrid), cold (Sonnblick), & a standard reference point (Heathrow)
2. I chose the years 2020, 1990, 1960 to review the best spread of data in the dataset.

HEATHROW



SONNBLICK



MADRID



Weather Station	Year	Theta0	Theta1	Iterations	Step size
Heathrow	1960	-4	1	200	0.2
Heathrow	1990	-3	1	150	0.2
Heathrow	2020	-2	1	100	0.2
Sonnblick	1960	-4	1	200	0.2
Sonnblick	1990	-2	1	100	0.2
Sonnblick	2020	-2	1	100	0.25
Madrid	1960	-4	1	200	0.2
Madrid	1990	-3	1	100	0.2
Madrid	2020	-2	1	100	0.25

Observations on Weather Station Temperatures Over 60 Years (1960-1990-2020)

Stations: Heathrow, Sonnblick, Madrid

Reduction in Loss Function Over Iterations

Looking at all three locations across the years 1960, 1990, and 2020

1. 1960 required higher iterations (200) for full convergence, especially in Madrid and Sonnblick, indicating it takes more time for the model to learn and improve.
2. 1990 showed improved convergence with adjusted Theta0 values, particularly for Heathrow and Madrid, leading to more efficient gradient descent.
3. 2020 achieved the fastest convergence, optimized by step size adjustments (0.25 for Sonnblick and Madrid)

Overall Temperature Increase Over Time

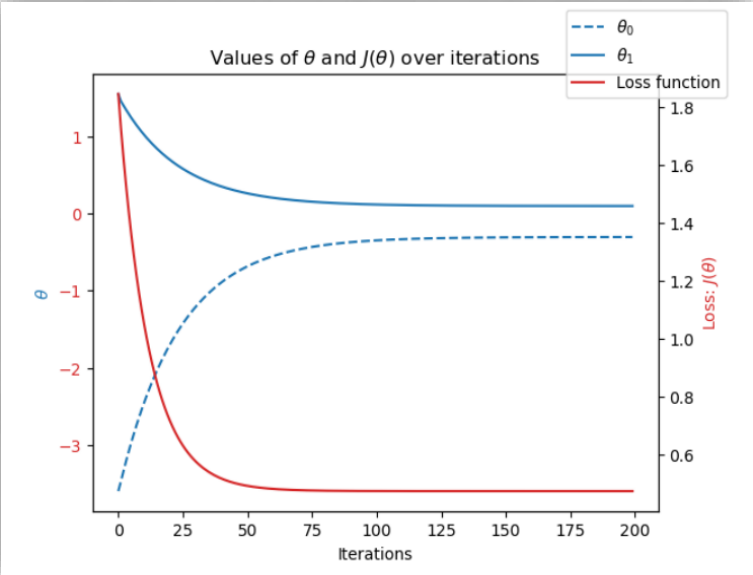
Across all three stations, the mean temperatures have increased from 1960 to 2020.

1. Heathrow: The mean temperature increased from -0.034 (1960) to 0.226 (2020), showing a consistent warming trend.
2. Sonnblick: The mean temperature increased from -0.078 (1960) to 0.275 (2020), indicating a significant rise despite being a high-altitude location.
3. Madrid: The mean temperature saw an increase from -0.063 (1960) to 0.279 (2020), supporting the trend of warming, in a traditionally warmer climate.

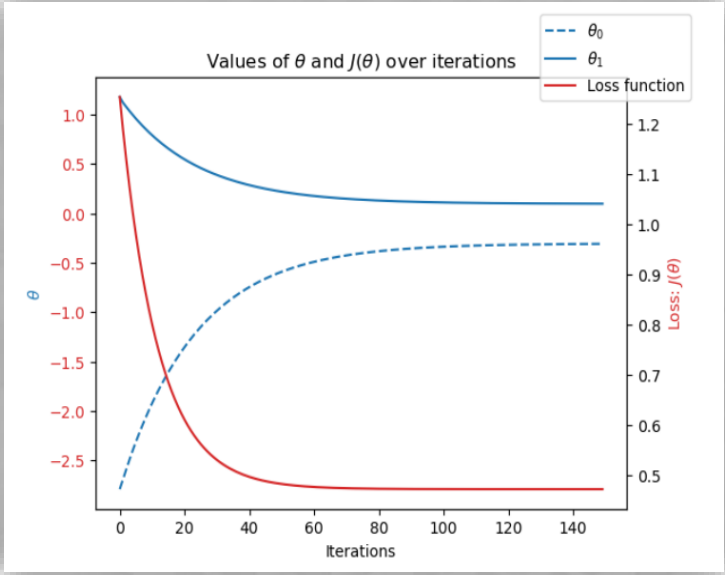
Temperature Variability and Extremes

1. Heathrow showed a reduction in cold extremes; in 1960, the minimum temperature was -2.87, while in 2020, it was -1.60.
2. Sonnblick, being a colder mountainous region, had the lowest minimum temperatures in all three decades. In 1960, it had an extreme minimum of -2.24, whereas in 2020, the minimum rose to -1.29, showing less extreme cold days.
3. Madrid shows the highest temperature variation over time, as evidenced by the higher standard deviation (STD) in 2020 (0.913) compared to 1960 (0.902).

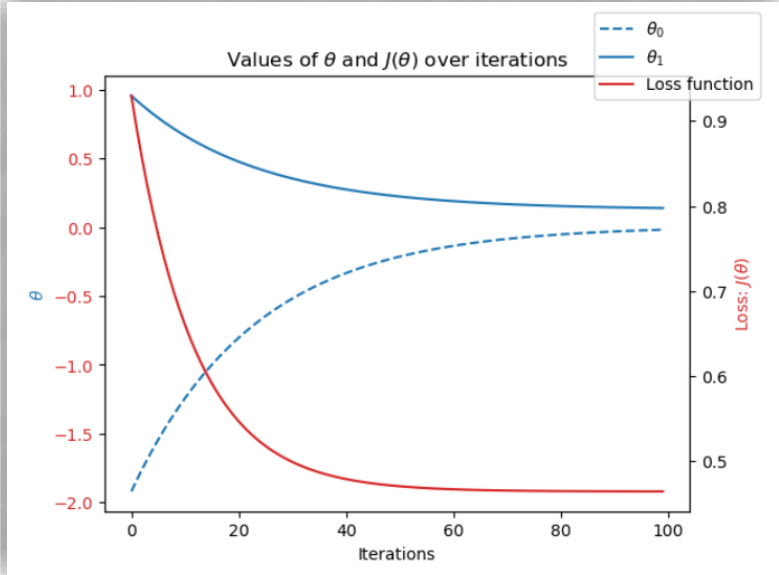
HEATHROW



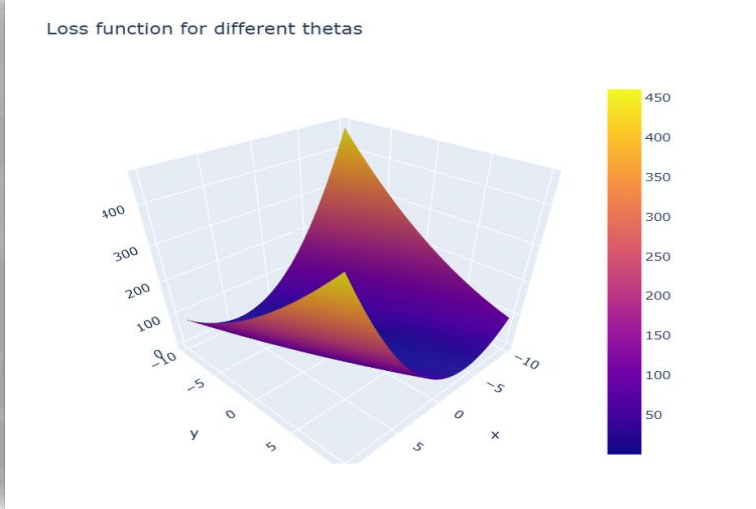
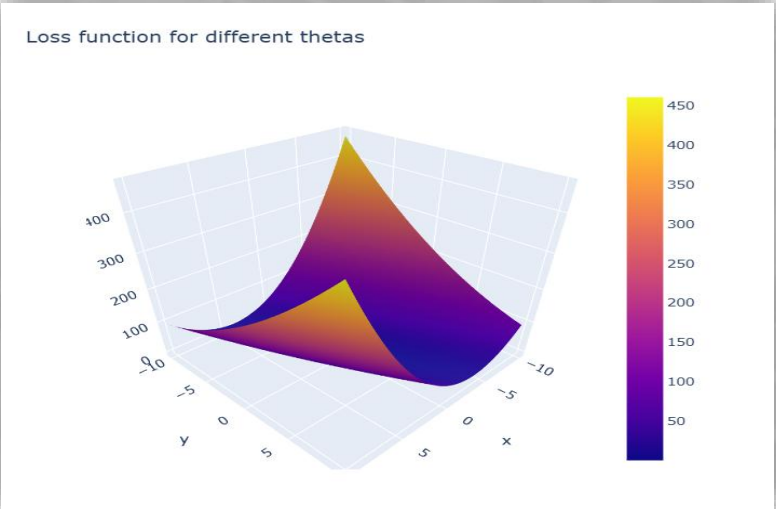
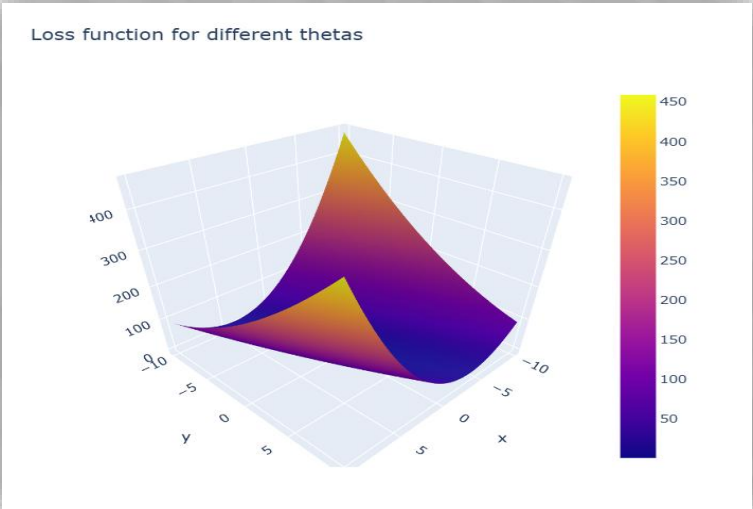
1960



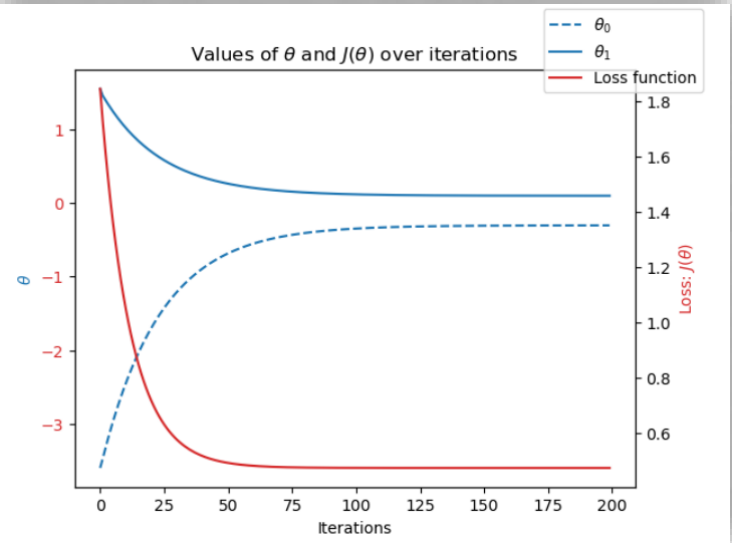
1990



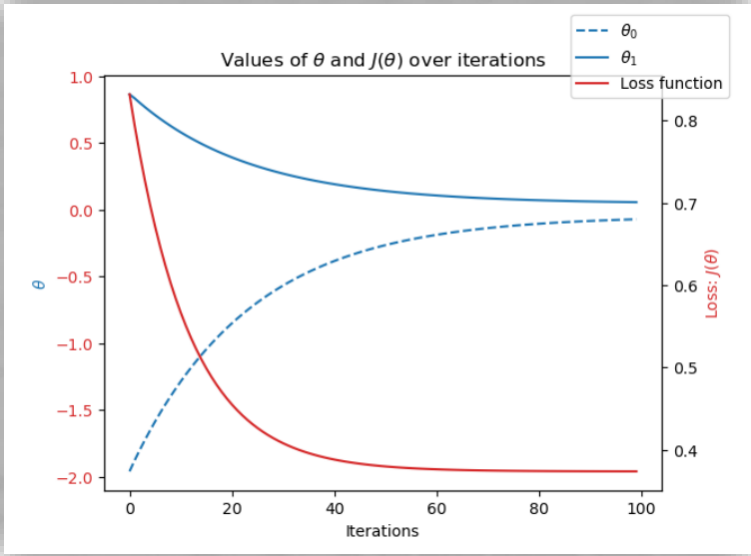
2020



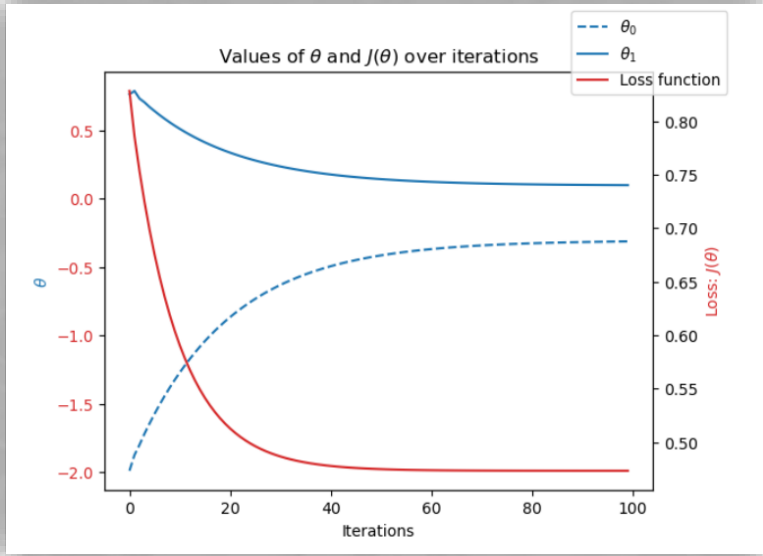
SONNBLICK



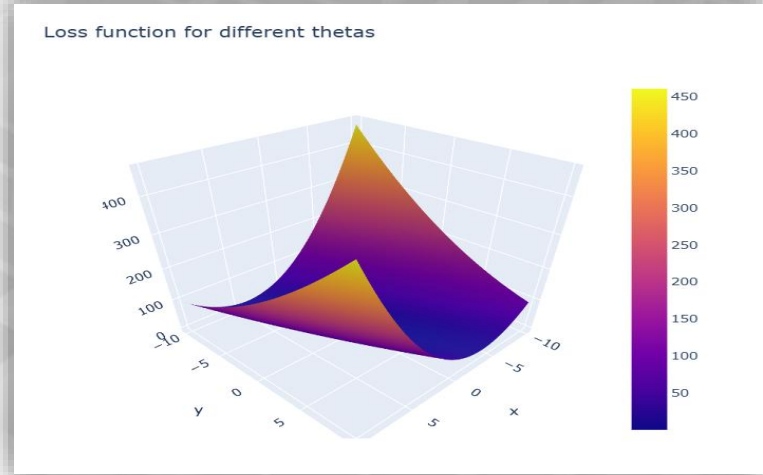
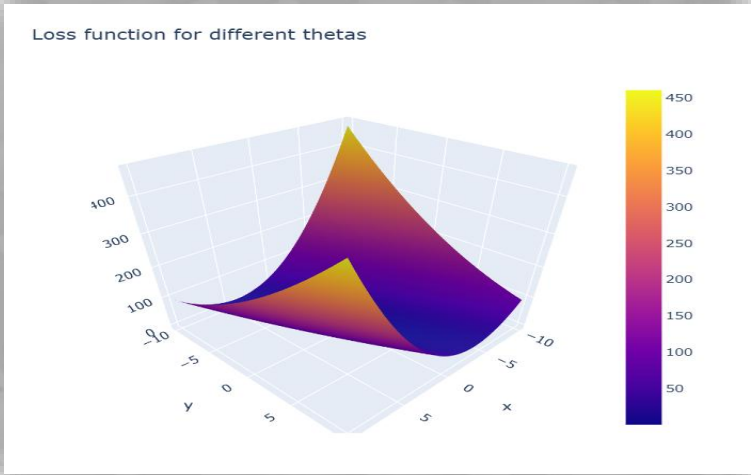
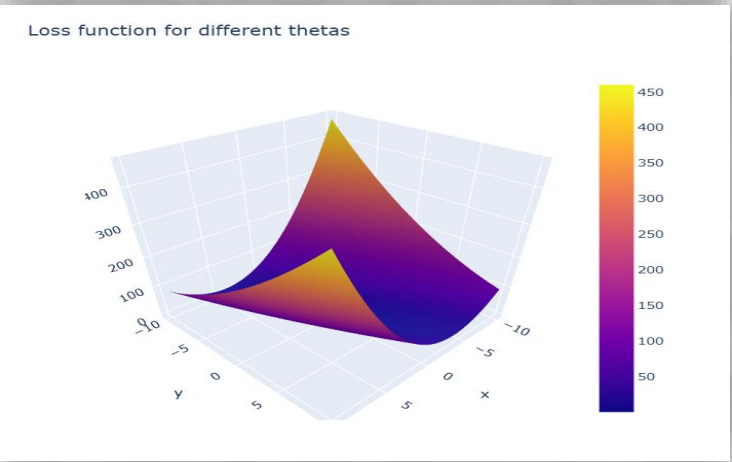
1960



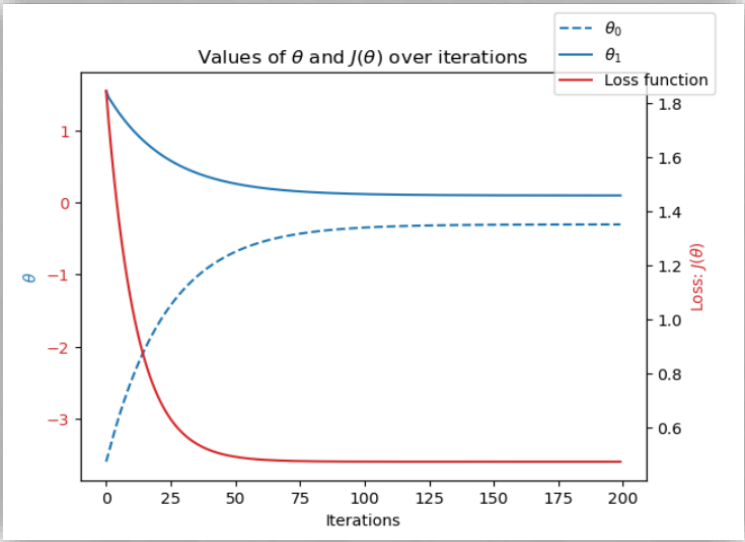
1990



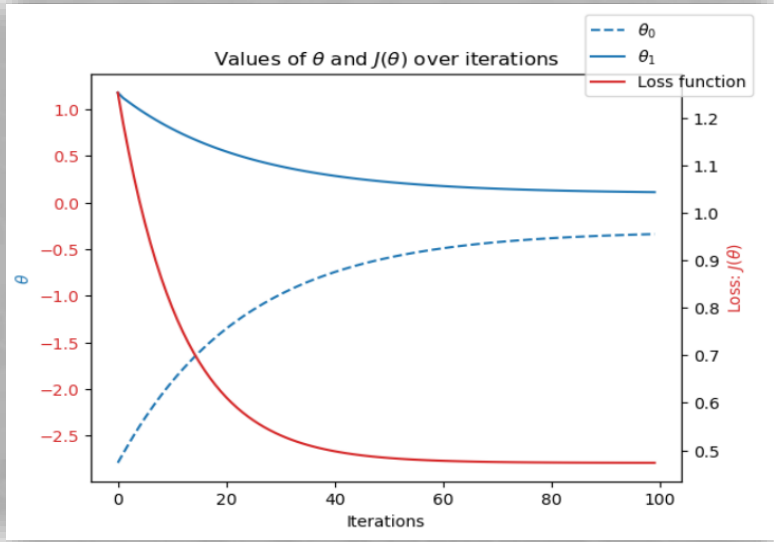
2020



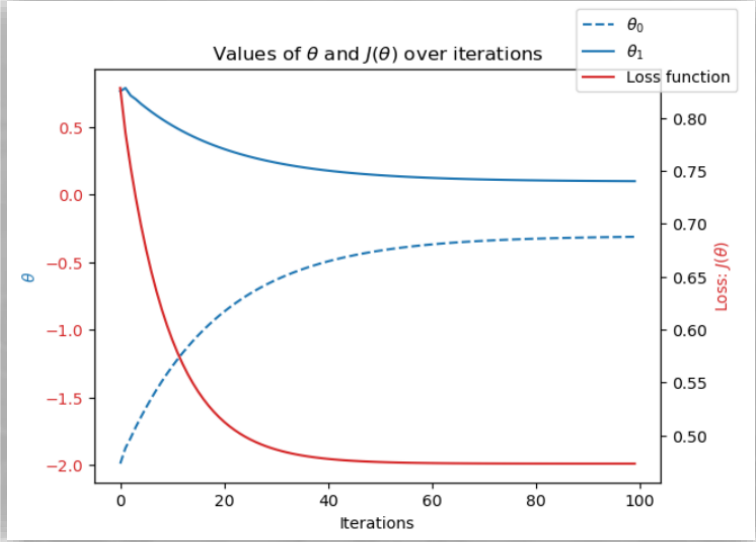
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1960



1990



2020

