CareerFoundry ML with Python
November 14, 2025
Charlotte Lin

Achievement 1.3:
Optimization in Relation to Problem-Solving

Gradient Descent Parameter Settings for All Weather Stations and Years

Weather Station	Year	Theta0	Theta1	Iterations	Step Size
Basel	1962	10	-10	100	0.1
Basel	1992	10	-10	100	0.1
Basel	2019	10	-10	100	0.1
Madrid	1962	10	-10	100	0.1
Madrid	1992	10	-10	100	0.1
Madrid	2019	10	-10	100	0.1
Stockholm	1962	10	-10	100	0.1
Stockholm	1922	10	-10	100	0.1
Stockholm	2019	10	-10	100	0.1

Observations about the weather station temperatures over the span of 60 years

All observations are based on the mean, min and max temperature studied in the analysis, which are visualized through scatterplots (see the Python Notebook for this exercise).

Basel	Madrid	Stockholm
1. Basel’s overall temperature trend shows clear warming over the 60-year span. Across the three years, the central “band” of temperatures shifts upward, which means that an average day in 2019 is noticeably warmer than an average day in 1962.	**1.** Madrid shows a clear warming trend across all three decades, with temperatures in 2019 consistently higher than in 1962 and 1992. Across the years, the entire temperature curve shifts upward, which indicates that both winter and summer days have warmed	**1.** Stockholm shows a strong warming trend over the 60-year period, with both winter and summer temperatures rising notably. The entire temperature curve shifts upward across the three years, which indicates that average temperatures have increased steadily from

2. Winter temperatures in Basel have become less extreme over time. In 1962, winter days regularly dropped below –2°C, while by 2019 the coldest points cluster much closer to –1°C, showing that the coldest days have warmed the most. **3.** Summer temperatures also increased, with higher peaks in 1992 and especially 2019. In 1962, the warmest days top out around 1.5–2°C, but by 2019 several points exceed 2°C, which indicates hotter summers and a broader range of warm extremes.	over time. This trend is similar to Basel but slightly less dramatically. **2.** The coldest winter days in Madrid have become noticeably warmer over time. In 1962, many winter days fall near –2°C or slightly below, while in 2019 the lower bound rises closer to –1.5°C. **3.** Madrid's warm season temperatures have increased modestly but steadily, with more days in 2019 reaching well above 1°C compared to 1962. The warmest points in 2019 reach around ~2.2°C, compared to ~1.5–1.8°C in 1962. Although this shift is not as steep as more northern European cities.	1962 to 2019. The increase in Stockholm is more prominent than in Madrid and comparable to Basel. **2.** The coldest winter days have warmed significantly, with 1962 showing many days near –2.0°C or colder, while by 2019 the lower bound rises closer to –1.5°C. This pattern of warming of the coldest days is consistent with climate trends in northern Europe. **3.** Stockholm's warm-season temperatures have increased the most between 1962 and 1992, and continued rising slightly by 2019. Peak temperatures climb from around ~1.3–1.4°C in 1962 to near 2.0°C in 1992, and several points in 2019 exceed 2.0°C, which shows a progressive intensification of summer heat.

Loss Function Charts and θ-Iteration Plots

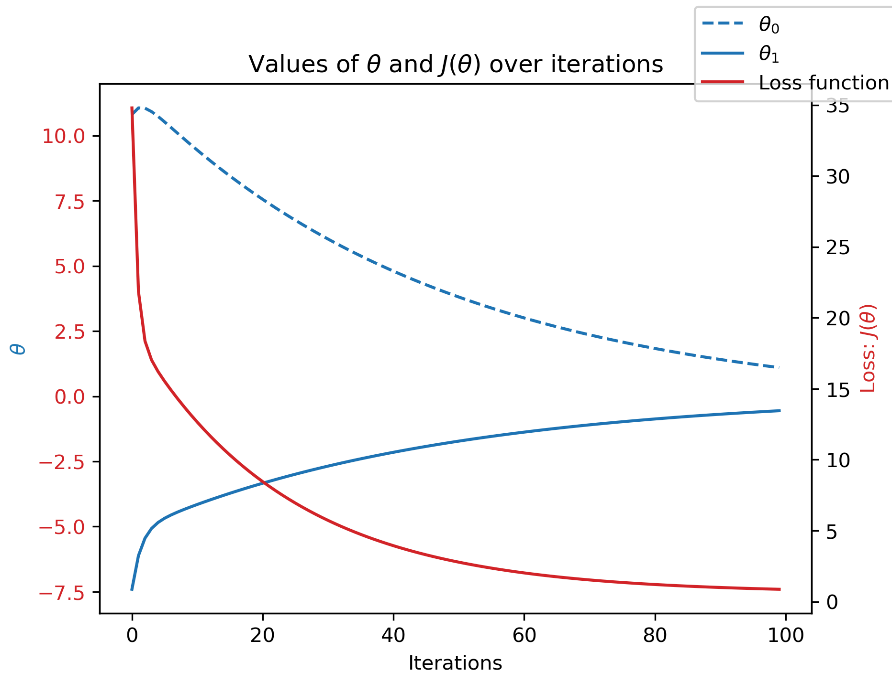
To complement the temperature trend analysis, the rest of the document shows each year-station pair with two gradient-descent diagnostics that help illustrate how well a simple linear model fits the seasonal temperature cycle.

1. θ-Iteration and Loss-Convergence Plot

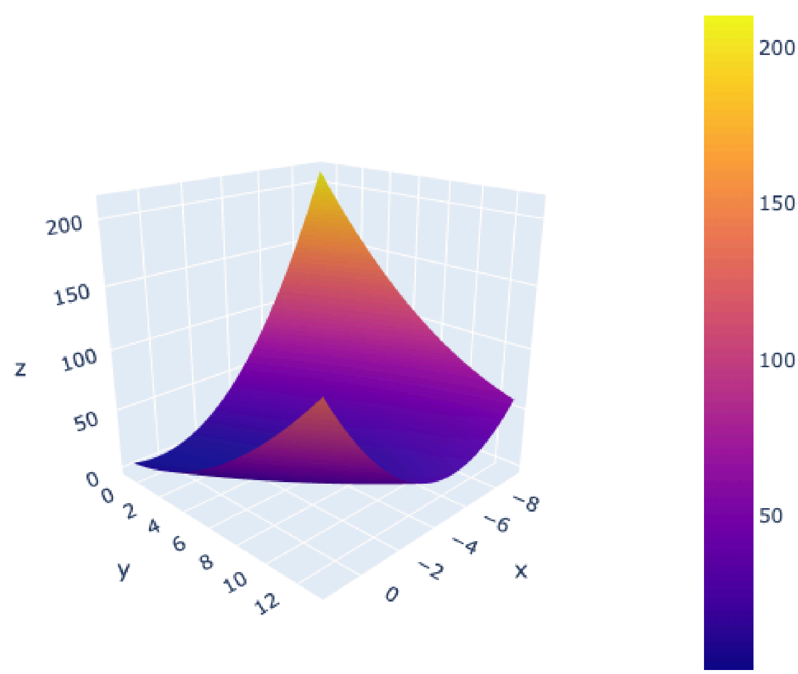
2. 3D Loss-Surface Plot ($J(\theta_0, \theta_1)$)

These two visuals show how easily (or not) a simple linear model can learn the structure of temperatures at each location and year, providing another window into comparing Basel, Madrid, and Stockholm across six decades.

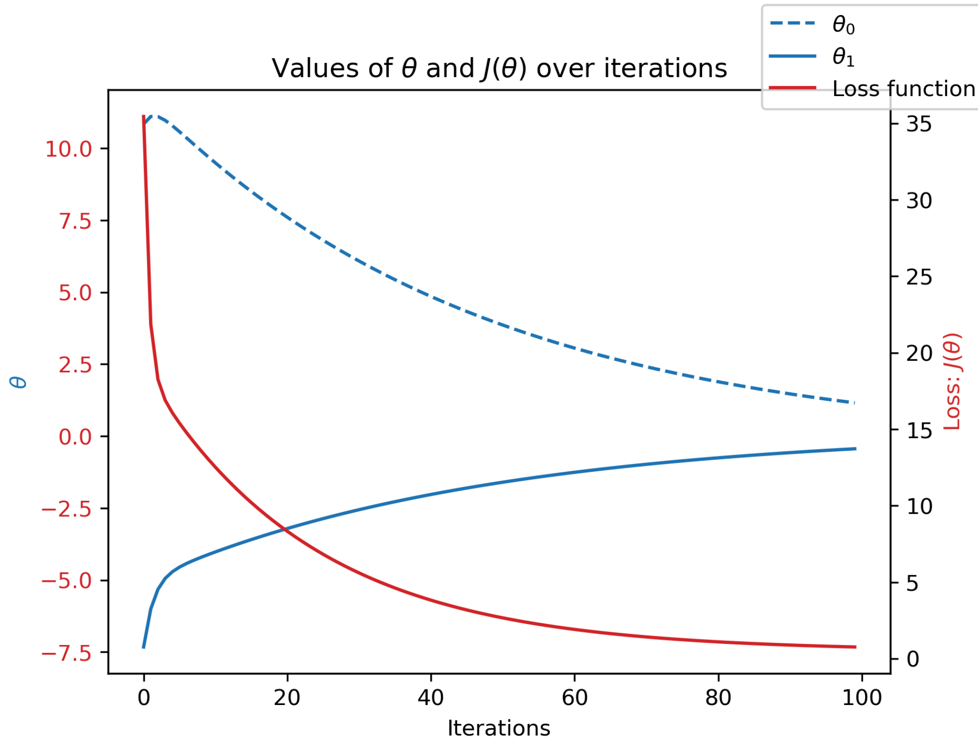
Basel 1962 Loss Function



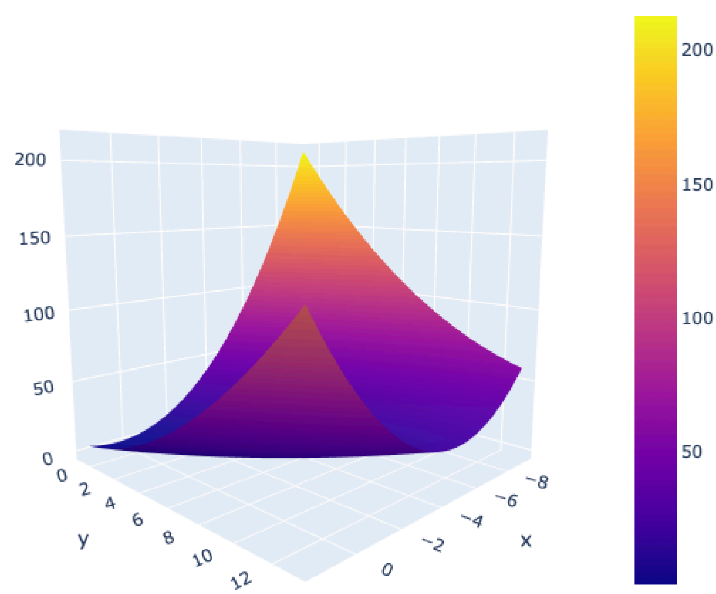
Basel 1962 Loss Theta Profile



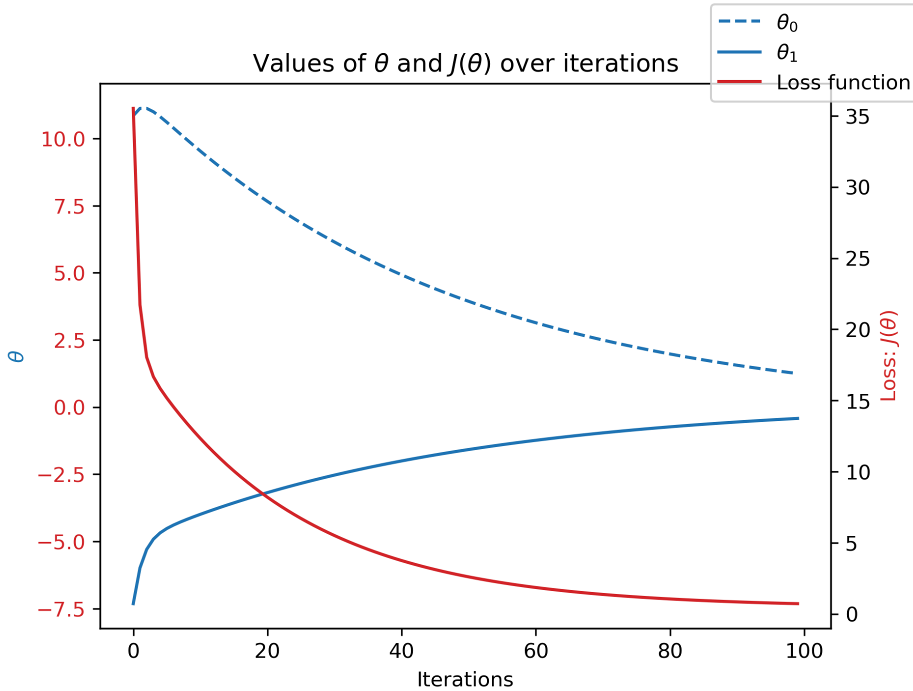
Basel 1992 Loss Function



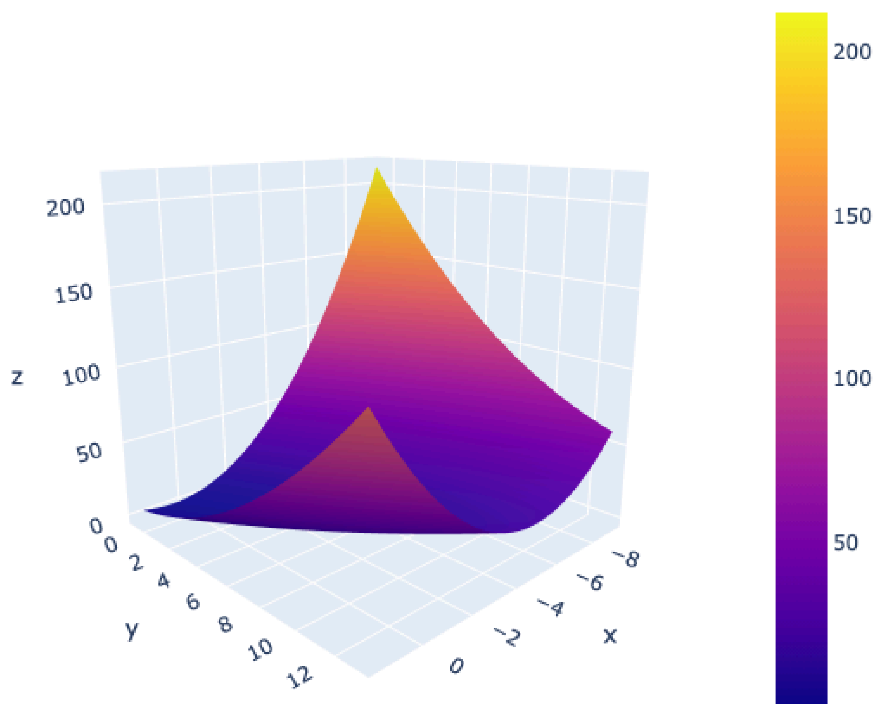
Basel 1992 Loss Theta Profile



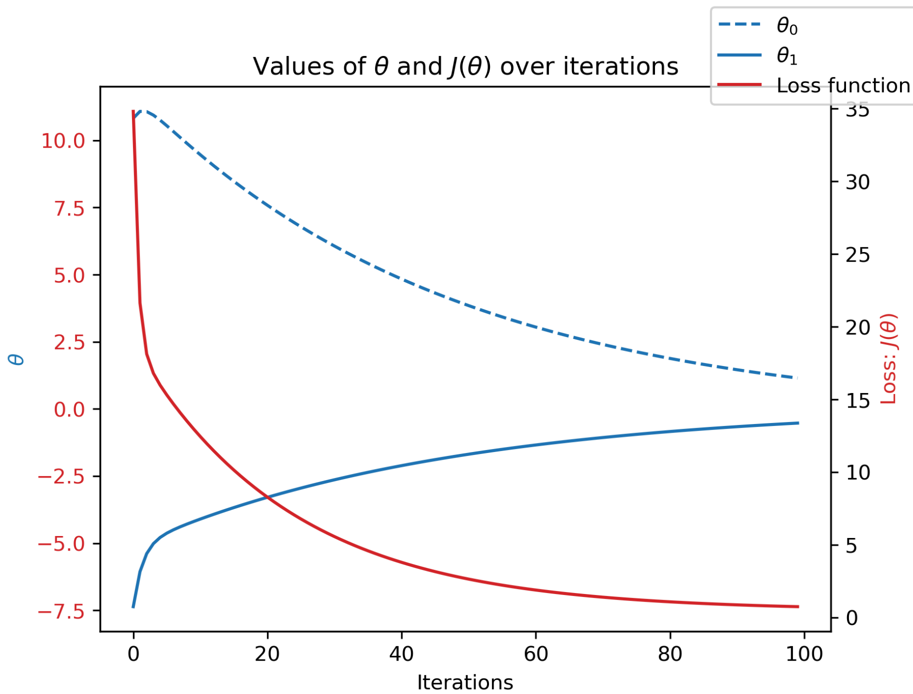
Basel 2019 Loss Function



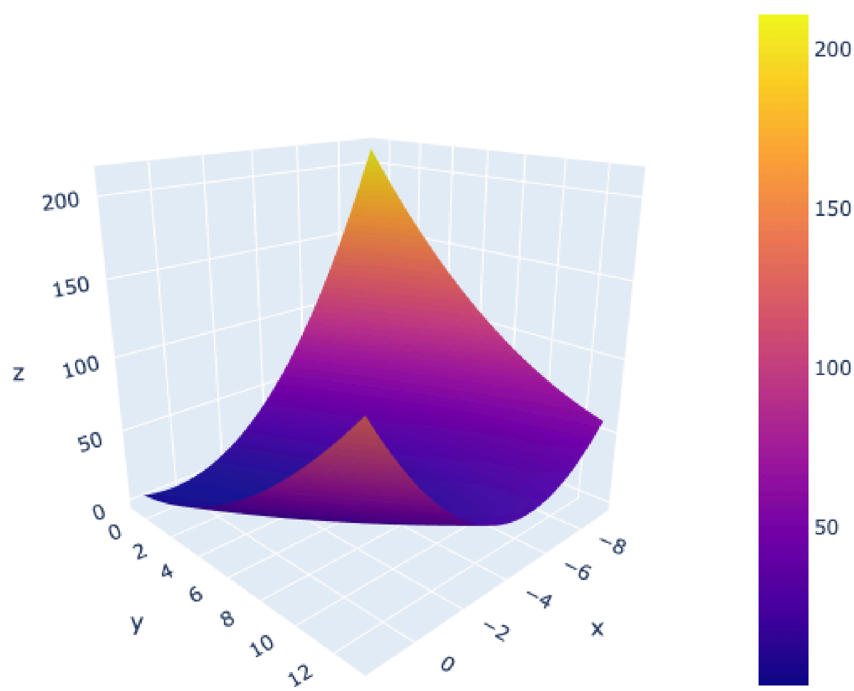
Basel 2019 Loss Theta Profile



Madrid 1962 Loss Function



Madrid 1962 Loss Theta Profile



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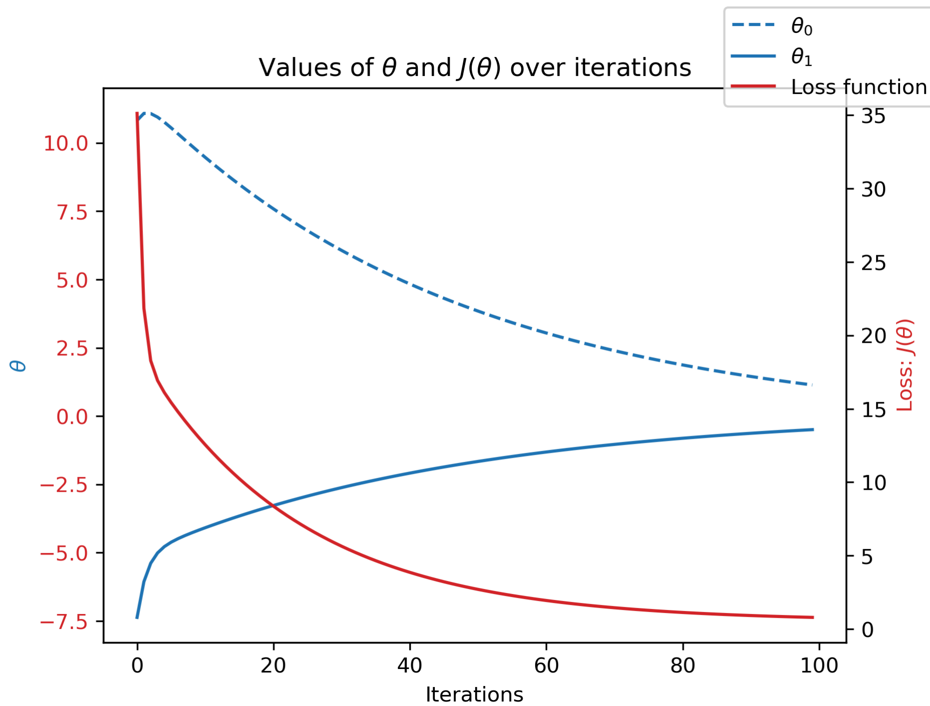
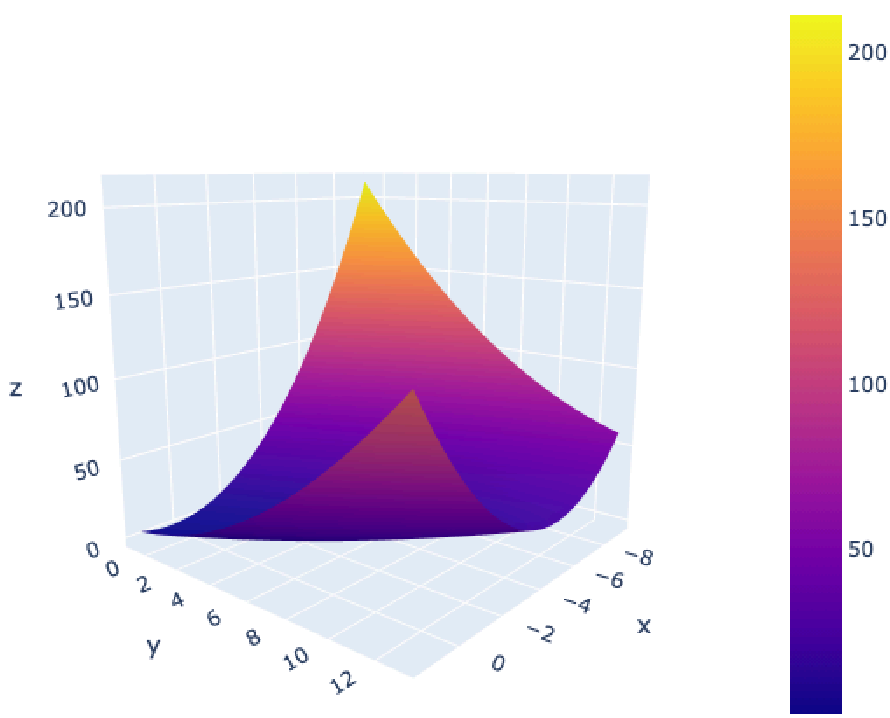
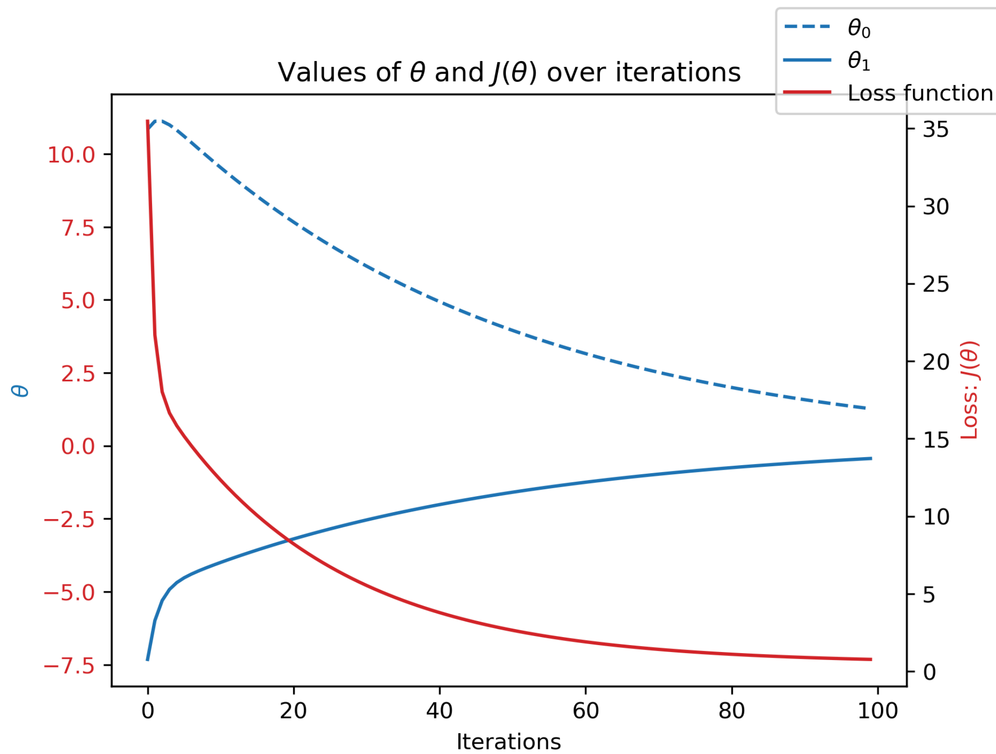


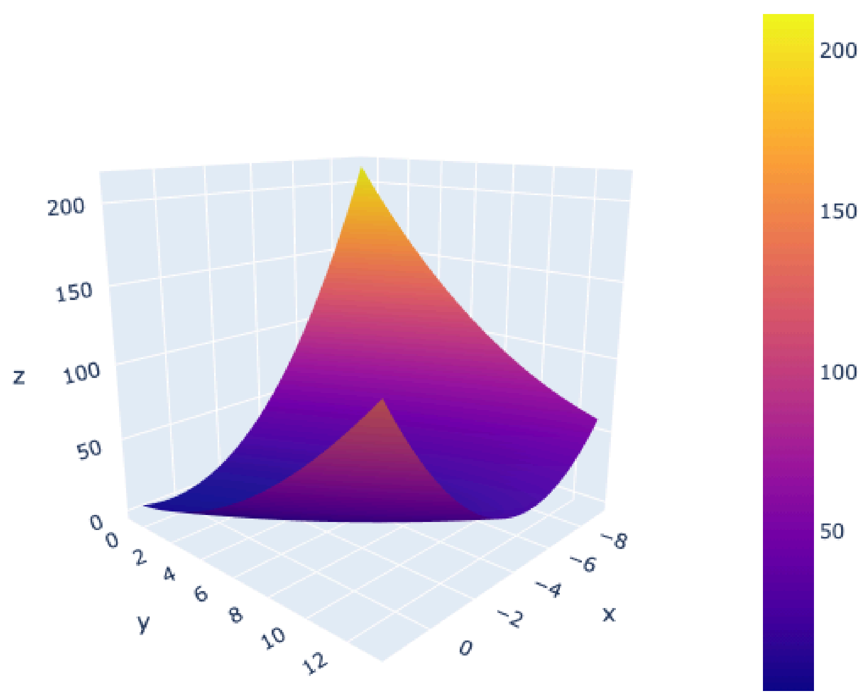
Madrid 1992 Loss Theta Profile



Madrid 2019 Loss Function



Madrid 2019 Loss Theta Profile



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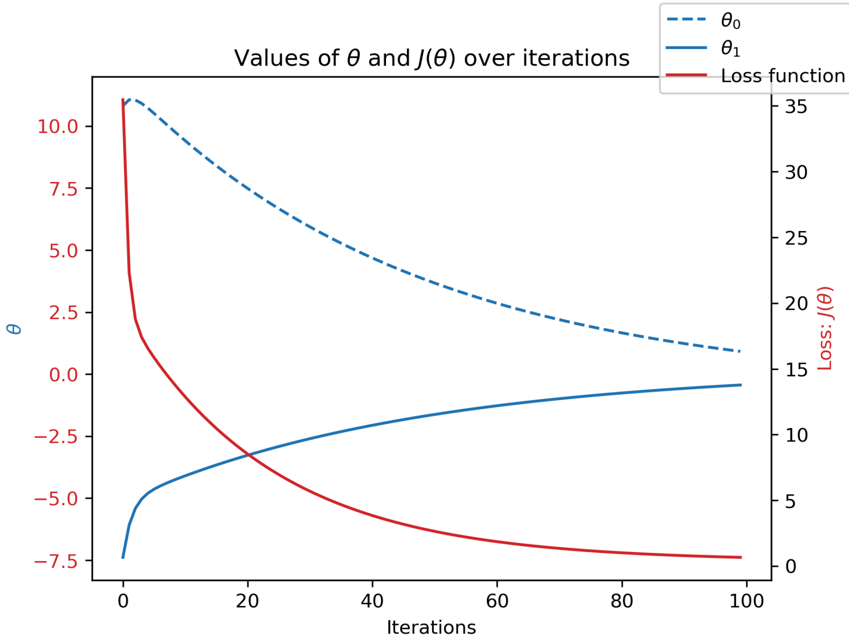
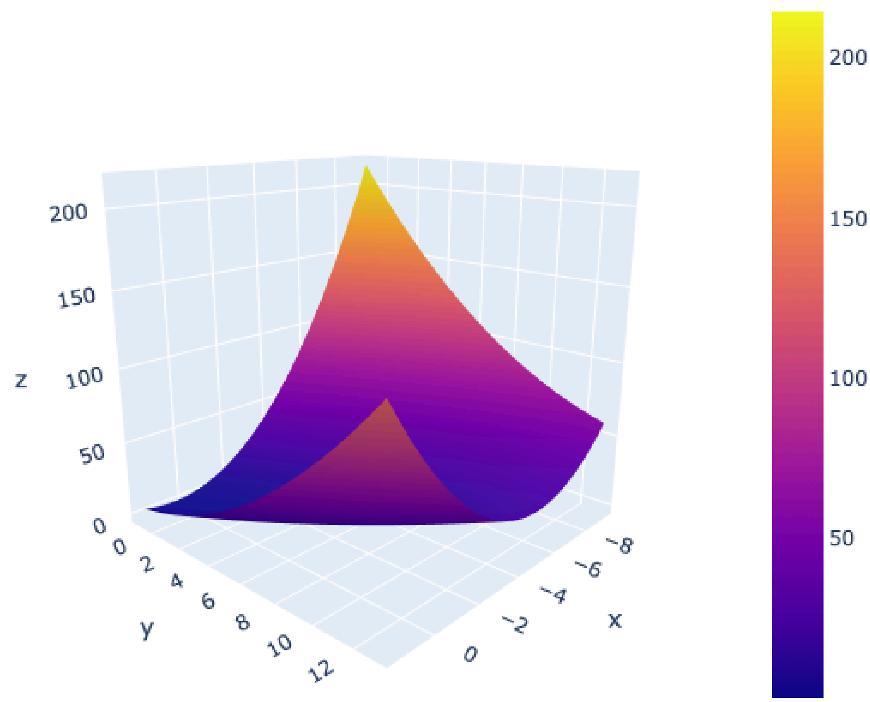
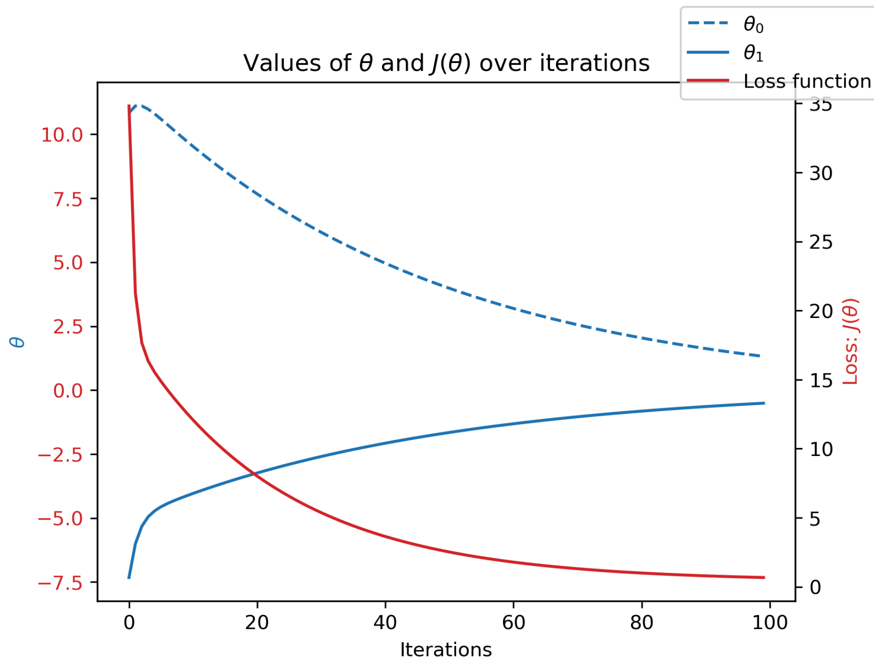
Stockholm 1962 Loss Function



Stockholm 1962 Loss Theta Profile



Stockholm 1992 Loss Function



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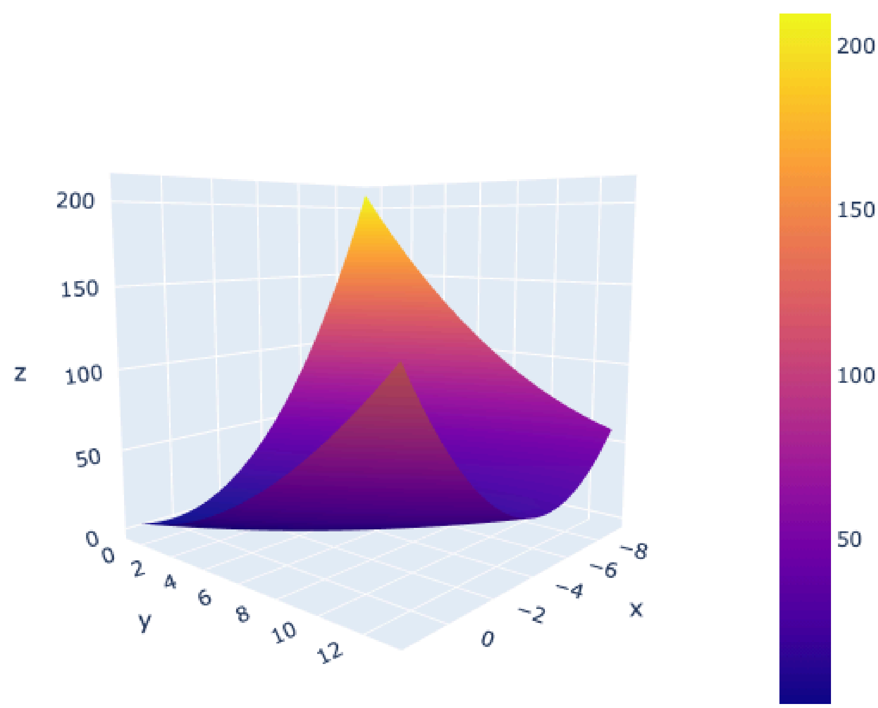

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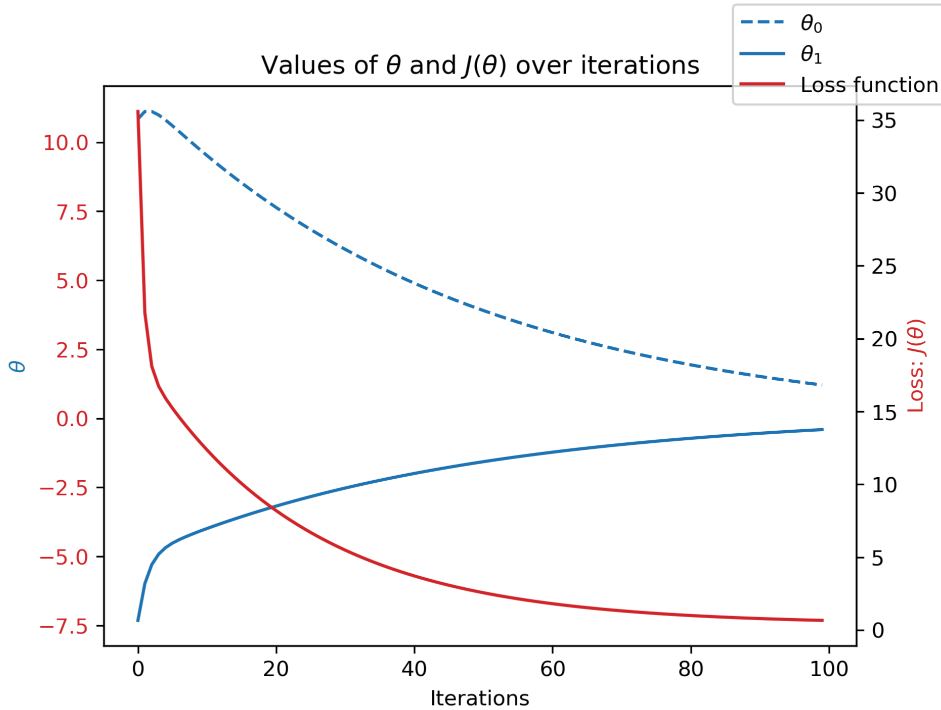

Stockholm 2019 Loss Theta Profile