EuroMCM Sample Problem β : Holding the Snowline

1 Background

The region around Zermatt, Switzerland, hosts some of the world's most renowned ski terrain, including the iconic Matterhorn Glacier Paradise and its vast international links. This area relies on interconnected systems of ski lifts and downhill pistes, allowing skiers to move from high-altitude glaciers at nearly 3,883 metres down to the base village at 1,620 metres during the winter season.

In recent decades, rising global temperatures have caused the natural snowline to move upward, reducing snow reliability at lower elevations. As a result, operators in the Zermatt area face increasing uncertainty about whether key downhill routes to the village can remain open. To adapt, significant investment has been made in artificial snowmaking, which improves reliability but consumes significant water, energy, and infrastructure. These resources are constrained by rugged high-alpine terrain, environmental regulations, and budget limitations. Resort operators must make strategic decisions about where to deploy artificial snow and whether some pistes should be modified, upgraded, or eventually closed.

2 Requirements

Focusing on a coordinating council responsible for long-term planning for the Zermatt ski area, your task is to determine the best mathematical approach to maintaining viable operations over the next decade. Specifically, you should:

- Develop a model to predict the location of the seasonal snowline over time and its impact on piste availability. Your model should identify how these changes affect the reliability of different zones within the resort and include an analysis of the uncertainties associated with these climate trends.
- Create a methodology to determine the optimal allocation of limited resources (water, electricity, and funding) for artificial snowmaking. Your model must balance the need for continuous downhill access (from high elevations to the Zermatt base area) with the economic costs of infrastructure and environmental constraints.
- Evaluate and compare different adaptation strategies, such as concentrating resources on primary "artery" routes versus shifting operations entirely to higher elevations and glacier areas. Use your model to predict the long-term evolution of the system and assess the resilience of your recommendations against fluctuating factors such as the rate of temperature rise, water availability, and volatile energy costs.

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3 Share Your Insights

Provide a one-page non-technical memo to the Zermatt Ski Coordinating Council discussing your proposed plan, its value for the resorts, and the trade-offs involved in your recommendations.

4 Submission

Your PDF solution (≤25 pages) should include:

- One-page Summary Sheet
- Table of Contents
- Complete Solution
- One-page Memo
- References
- Report on Use of AI Tools (if applicable; excluded from the 25-page limit)

There is no mandatory minimum length. Teams may submit incomplete solutions. The use of AI tools is allowed but optional; compliance with EuroMCM AI usage policy is required.

5 Links

Sustainability in Zermatt

Matterhorn Ski Map

Switzerland Snow Depth

Snow Moving to Higher Elevations: Analysing Three Decades of Snowline Dynamics in the Alps

6 Glossary

Snowline: The elevation above which snow accumulation is sufficient for skiing during the winter season.

Artificial Snowmaking: Human intervention to produce snow using water and energy to supplement natural snowfall.

Downhill Accessibility: Continuous skiable routes from upper elevations to base areas, essential for a successful season.

Resource Constraints: Limits on water, energy, infrastructure, or finances that affect snowmaking and piste maintenance decisions.

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