RPTU

Data Science for Social Good fellowship

Data Science and its Applications

DFKI DSA

Speeding up ambulance services through demand forecasting and positioning recommendations

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INTRODUCTION

In health emergencies, every minute is crucial, as for ambulance services, a 1 minute can mean a **24%** increase in survival chance (e.g., in the event of the heart attack).

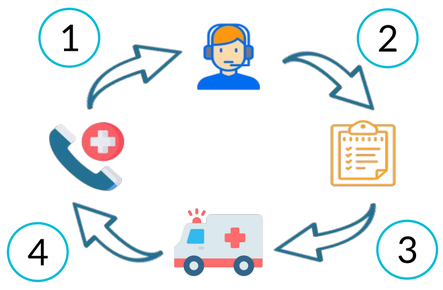
400+ ambulances

<15 mins response time

700k+ emergencies/year

DRK (Deutsches Rotes Kreuz) in Rhineland-Palatinate, handles emergency calls by dispatching appropriate ambulance vehicles.

CURRENT PROCESS



Currently, during emergencies, dispatchers assess a list of nearby ambulances from the control center and assign the closest one to the scene.

It is a legal requirement that at least 95% of ambulances arrive within 15 minutes.

GOALS

Improving **emergency response time** by optimizing ambulance arrival time across the region.

Predicting call volume by location and time using historical data.

Proactively moving ambulances to areas with anticipated demand but limited coverage.

METHODOLOGY

Data

Data from 2018-2023

Emergency Call Data

Demographics

Weather

Openstreetmap (OSM) Data

Preprocessing

OSM analysis

Extract OSM road network:
Nodes (intersections)
Edges (roads)

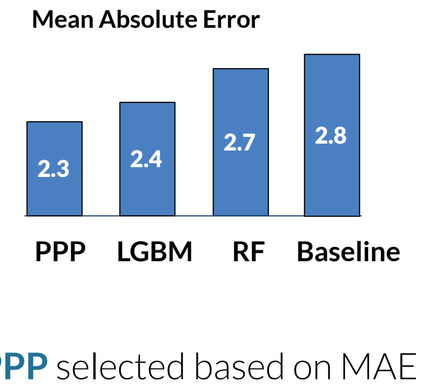
Location Clusters

Clustering the nodes for simplification.

Demand Prediction

Predicting volume of calls per time and node of the street network, using ML and statistical models.

- LightGBM (**LGBM**)
- Randomforest (**RF**)
- Poisson point processes (**PPP**)



PPP selected based on MAE

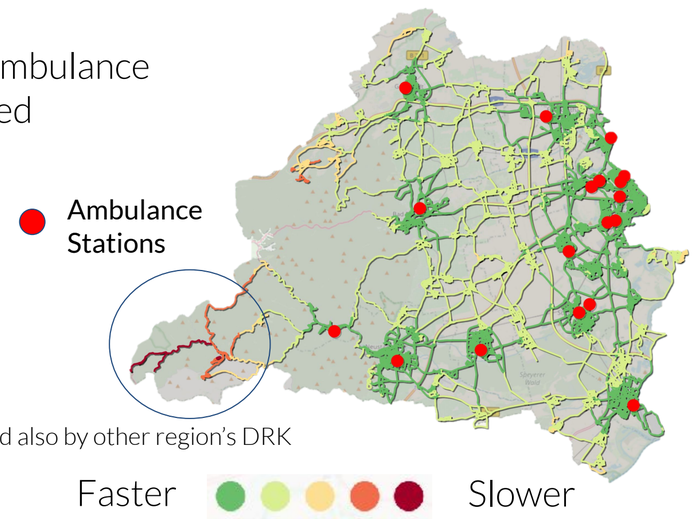
Coverage (Travel Time)

The calculation of travel time of an ambulance to any location using **LightGBM** based on following features:

Weather

Time of day

Siren On/Off



Spatial Index

The spatial index of a node is the probability that an ambulance can reach it under 15 minutes and taking into account:

Demand Forecasting

Ambulance Count

Ambulance Arrival Time

Ambulance Return Time

The index is summed over space to give a **score** to any given ambulance placement

Ambulance Relocation Recommendation

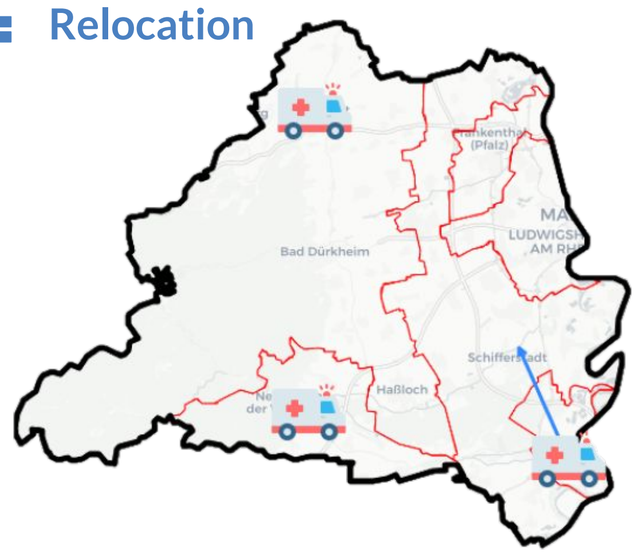
Based on **spatial index**, **station locations**, and a list of **additional possible locations**, the head dispatcher periodically gets a recommendation if any ambulances should be **proactively relocated**.

Spatial Index + Flexible locations + Ambulance Stations = **Relocation**

Close to demand

Not close to stations

Near to amenities



Results

Our simulation shows that by using our relocation recommendation, DRK can now reach

30%

reduction in the number of calls that wait >15 minutes previously.

Reach **110** calls/year that were not reachable under 15 minutes previously.

35% improved estimation for travel times

10% better call volume prediction than historical baseline.

Our Thanks

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