Home Exam 2: Real-World Measurements

In this home exam, we will focus on real-world mobile scenarios by exploring and analyzing datasets collected by conducting large-scale measurements on commercial mobile networks.

More specifically, you will be given a dataset that is composed of coverage measurements for different operators and radio technologies (LTE and 5G). These measurements are conducted in different locations and under different settings. Your task is to compare the coverage performance for different scenarios both in space and time and evaluate whether the differences you observe are statistically significant.

The delivery consists of a presentation suitable for projection in the classroom. The exam comprises both the presentation as delivered and your oral presentation in the classroom including the handling of questions.

# TASK

5G is gaining momentum and its deployment is rapidly progressing worldwide. In this task, you are given large-scale measurement campaigns of 5G and LTE data (collected in Rome, Italy) in order to empirically analyze the coverage performance of 5G and LTE on operational networks under different settings.

The measurement campaign was designed to explore city-wide coverage under heterogeneous scenarios. It covered a period of two months (early April - late May 2023). The number of campaigns across the three technologies are different and described below:

**4G and 5G:**

* Indoor (477 sub-campaigns), for houses and multi-floor buildings
* Outdoor Driving (236 sub-campaigns), for outdoor while driving
* Outdoor Walking (2 sub-campaigns), for outdoor while walking
* Indoor Walking (5 sub-campaigns), for indoor while walking

A subset of the measurements is replicated over time (i.e., morning vs. afternoon vs. evening, and week vs. weekend), to account for temporal effects.

For more details on the data collection and dataset fields of the data, please see the papers provided. Here you can also find some analysis of the datasets.

Your task with this assignment is to dig deeper and provide coverage performance comparison for different scenarios in time and space. You can select any of the below scenarios (or their combination) for your analysis:

* Given a selected number of different (sub-)campaigns, compare the coverage performance of different operators (further dissect per frequency band) and different technologies (4G, 5G).
* Given two or more sub-campaigns at the same location (e.g., repetitions of indoor/outdoor campaigns), show how the coverage changes over time.
* Given a single operator, compare the coverage performance across different locations or scenarios. HINT: Particularly interesting for OD campaigns
* Other aspects to evaluate:
	+ Does speed affect coverage performance
	+ What beamforming strategies are followed by each operator
	+ Feel free to evaluate other aspects of the data
* Analysis of variance. How significantly different are the different data groups?

# Presentation

* Make a visual classroom representation, in the spirit of a short lecture. Select a tool such as Powerpoint or Google Slides which allows you to download and hand in complete assignments. Tools to present results more interactively (Matlab, Jupyter Notebook) are great in many contexts but not for delivery as homework. Deliver a PDF version of your presentation as well.
* The presentation must:
	+ explain the goals of your analysis
	+ explain which scenarios you have chosen to analyze, and how you approached the analyses
	+ present your results visually using plots (there are many examples in the intro lecture)
	+ explain the results
	+ explain how the plots assist you in explaining these results
* Present in the classroom.
	+ The presentation that you deliver is not a report. It should be very brief (using bullets) for each requested explanation. The oral presentation in the classroom should be more detailed.
	+ It is important to use statistical tools and enough samples to make your case, as real measurements always have measurement noise.

# Deadline

The presentation must be sent to the lecturers through email before October 17 at 12:00 (before the course starts).

The final delivery of the assignment must be submitted on October 25, 2023.