

## TIØ4285 Production and Network Economics Deliverable 1

This deliverable counts for 10% of the final grade. Please note that there will not be an individual score for this deliverable.

**Out: Thursday 11 February**

**In: Thursday 25 February 6pm**

**Late answers are not accepted.**

### General Advice

- You can work together in groups of up to 3 students. Collaboration between groups is not allowed and considered cheating.
- Please read the questions carefully and answer to what is asked. Keep your answer short (but as long as necessary) and concise.
- Base your answers on the contents taught in this course (or previous courses).
- If you make any assumptions that are necessary to reproduce your results, make sure you mention them in your report.
- Document how you find your results. You have to provide either calculations or sound logical reasoning.

### Exercise 1

As part of a company's quality management procedures, the location of hole is measured regularly and its deviation from the intended position is logged. To get a better understanding of whether not the production process is stable, they would like to have a prediction model for future deviations. See Excel-file **exercise01.xlsx** for the last 150 measurements.

- a) Discuss suitable forecasting methods with respect to the time series given in the Excel-file **exercise01.xlsx**.
- b) Select a forecasting method and create a forecast for the next measurement. Discuss the quality of your forecast.
- c) Could you use your forecasting model to not only predict the next measurement but the next 3 measurements? Explain how you would do that and reflect upon the model's possibilities and limitations.

## Exercise 2

A company has two factories, one at Liverpool and one at Brighton. In addition it has four distribution centers at Newcastle, Birmingham, London, and Exeter. The company sells its product to six customers C1, C2, ..., C6. These customers can be served from either the distribution centers or directly from a factory (see Figure 1).



Figure 1: Production and distribution network (transportation links not shown)

See the worksheet “General Data” in Excel-file `exercise02.xlsx` for information on production and throughput capacity as well as distribution costs for the different locations. If no distribution cost is provided, transportation is not possible.

- What type of planning problem does the distribution planning problem represent? Explain briefly.
- Formulate an optimization problem that finds the cost minimizing distribution pattern for satisfying demand. Remember to introduce your notation and explain the model. Find the optimal solution for the demand information on worksheet “Exercise 2b” in Excel-file `exercise02.xlsx`.

Now consider the situation that the company has to decide upon a general distribution plan for how to supply customers and distribution centers before they actually know customer demand. After demand information has become available, it is no longer possible to ship products to customers from a distribution center once its inventory is depleted, but the company can use express services to deliver missing products from a factory (given that distribution is possible) at twice the regular distribution cost. Assume that each distribution center can store products according to their throughput capacity.

- How does the new situation change the assessment you made in Exercise 2a? If it changes your assessment, explain why and how. If it does not change your assessment, explain why not.
- Discuss how you have to change your model from Exercise 2b to provide decisions support for the distribution planners of this production network. Which decisions would be implemented first by them?
- Suggest and formulate a stochastic programming model, taking into account the changes you have discussed in Exercise 2d.

- f) Solve the problem you formulated with the two different scenario set demand data on worksheet “Exercise 2f” in Excel-file **exercise02.xlsx**. Discuss the results. What is the impact of correlation in demand?