Fundamentals of Traffic Operations and Control
In-class exercise (date 29/11/2017)

Problem 1
A machine produces a single product in a production rate of 500 units per week. The product is transported in fixed time periods and in constant quantities to the factory store. Assume that the transshipment is immediate and that it costs CHF 100, to be paid by the store. The product is sold at the factory store in a rate of 400 units per week. A setup cost of CHF 450 is incurred every time the machine restarts production. In addition, the holding cost of a unit in the inventory is CHF 2 per week (both in the factory and in the store).

(a) Draw a graph representing the inventory level at the factory over time.
Hint – recall that the production rate is constant, but notice that the production rate is higher than the demand rate (i.e., the machine does not operate constantly).
(b) Write a function that represents the costs of the factory per week. What would be the optimal production quantity and what is the minimal cost for the factory?
(c) What would be the weekly cost for the store if it receives orders in the quantity and frequency calculated in (b)? What is the joined cost for the factory and the store?
(d) Redo the sequential calculation in (b) and (c), but now first calculate the optimal quantity and frequency for the store and then calculate the costs implied for the factory. Discuss the differences between the two solutions.
(e) Write a function that represents the cost for the entire system, what is the minimal cost for the entire system?

Problem 2
A toys salesman estimates that the demand for his toys in an upcoming fare is distributed uniformly between 120 and 200. The salesman buys each toy from a disributer at cost of CHF 5 and sells the toys at the fare in price of CHF 7. The distributer agrees to purchase back (after the fare) any remaining quantity for CHF 1.

(a) How many toys should the salesman buy?
(b) Repeat (a) assuming that the demand is distributed normally with a mean of 160 and a standard deviation of 23. Compare the results.
(c) Draw a graph that represents the buying quantity as a function of the buying cost, assume the buying cost may vary between CHF 1 and CHF 7 (for both demand distributions).