IE375 Fall 2020 Homework IV - Due: December 11 (Friday 17:00)

- **Homework IV is 2%. Make sure that you review course material before you start. Cite sources used if any.**
  - **Grading Policy:** The homework grades will not be only based on the correctness of the answers provided, but on the perceived degree of effort on the returned assignment. This means that even without obtaining the correct answers one can obtain full credit. The grade scale will be "2" (full effort, all questions); "1" (some effort or full effort, some questions); "0" (no effort or no submission). The submissions that exceed expectations may get a bonus – grade will be "3" (extra effort). Note that "2" corresponds to a grade out of 100% - 2% of the overall grade in this case. Late submissions will not be accepted.
  - The grading scale for each question is 2 points (full effort), 1 point (some effort), and 0 (no effort or no submission). Total points that would lead to your overall HW grade are given below:

Total Points	HW Grade
4+	3
3-4	2
1-2	1
0	0

  - **Academic Dishonesty (taken from IE375 Course Information):** Academic misconduct is not tolerated, and violations will be treated in accordance with the University policy. For assignments: Discussion of the course material and working in groups are effective ways of learning. However, this does not mean that you can copy the assignment from one of your friends. You can discuss with your friends, but you should be alone, without any written solution in front of you, when you prepare your assignment. It is extremely important to understand the value of this exercise in the process of learning. Any violation of the above understanding will result measures outlined in the student rules and regulations.
  - **Submission Information:** Please send your solution as a pdf file to IE375 Course TA Egemen Elver. Make sure that pdf contains your name, and you mail it from your mail account available in STARS. Also note that if your mail is different than the one provided by Bilkent University, there is a chance that it will be received after the due time.
- **More Information on Questions: What is expected? How to study?**
- To answer the questions, make sure that you understand the material presented during the course, as well as you have already the reading from the textbook. Homework IV is mostly made up of both conceptual questions as well as questions with numerical computations (rather than pure modeling). For computational questions, the key is to understand how standard methods are applied and interpret the results. In this homework, some computational require you to know how to use normal distribution tables. Almost all questions are taken from previous years" exams. Question 1 is on newsvendor problem, requiring you to understand the problem thoroughly, as well as computations with normal distribution. Question 2 is a standard (Q,R) problem, with normally distributed lead-time demand. Question 2 asks you to do some derivations; In general, you are expected to make such derivations during the exam.
- **One final remark:** In the exams, please get used to receiving question types that you have not seen before. One useful purpose of homework and exercises is to cover the "routine" so that you can go beyond that during the exams, and elsewhere.

1) A sports club prepares for the celebration of a possible 20^{th} championship of its football team in the junior league. The team has many supporters, and the management thinks that they should be well-prepared for the possibility and plan the number of high-end sweatshirts to procure from Italy. The unit cost of the shirt to the club is 32 TL, and it will sell for 130 TL. Any sweatshirt not sold by the end of the short celebration period is purchased by regular stores to 20 TL/piece. As a result of several detailed analyses the demand for sweatshirts in case of a championship is decided to have a normal distribution with a mean 150 (thousand) and a standard deviation of 30 (thousand) units.

a) Determine c_u (cost of underage) and c_o (cost of overage) values for the above problem.

b) What is the ordering quantity (in thousands of shirts) of the retailer to minimize its expected total cost? (You need to use the normal table supplied.)

c) Given that the ordering quantity is y*, what is the expected number of sweatshirts not sold? Write the expression in terms of y* and compute.

d) Given that the ordering quantity is y*, what is the expected excess demand for sweatshirts? Write the expression in terms of y* and compute.

2) The inventory of a purchased item is controlled with a continuous review (Q,R) policy. The item demand over 4 weeks of lead time follows a uniform distribution with a mean of 500 units in the interval of (200, 800). Fixed cost of ordering is $300, and the unit carrying cost per week is $0.18. Shortages are backordered at a cost of $6 per unit.

a. Write down the expected annual cost function. (assume 50 weeks in a year)

b. Find the conditions that will yield the optimal solution for Q and R.

c. Solve for Q and R. It is sufficient to represent Q and R values – i.e. the precision required – by numbers with only one digit after the decimal point.

d. Compute the expected annual optimal cost.

e. What is the Type-1 and Type-2 service levels attained with this solution?