Written exam – Logistics – July 5th, 2023

Exercise 1

Given the time series in the attached file,

- find whether it has a seasonal component or not, studying its auto-correlation,
- select a suitable forecasting model,
- make a forecast for the next periods.

Optional: Develop more than one model and compare the results.

Exercise 2

A Regional Distribution Center keeps the stock of a product whose estimated demand is 10000 units per year. Its obsolescence coefficient is 12% per year. Each reorder operation costs 2000 €.

The base price of the product is 150 €/unit. However, when more than 500 units are ordered, there is a discount of 1/15 of the price and when more than 2000 units are ordered, the discount is 1/10 of the base price.

Classify the inventory system and determine:

1) the economic order quantity
2) the optimal reorder period
3) the yearly cost of the inventory

Consider both discount policies: incremental discounts and total quantity discounts.

Exercise 3

In a logistic hub, some employees are in charge of packing the items to be delivered. Currently, there are 3 employees, who work at the same average speed: each employee packs 12 items per hour in average and the time he takes is a random variable with an exponential distribution. Items arrive at a rate of 20 per hour according to a Poisson distribution of the interarrival time.

Classify the system, evaluate its utilization factor and its main performance indicators.

The production manager needs to move one of the employees to a different task. Before taking any decision he wants to know:

a) what is the expected degradation in performance of the system if nothing else changes?
b) how many items each employee should be able to pack in one hour (in average) so that the expected time for each item to traverse the system remains unchanged?

He is also considering the option of replacing all employees with a machine that would pack all items following a completely automatic procedure with constant time. Evaluate the speed that the machine should have to keep the expected traversal time unchanged.

Exercise 4

A certain number of items of different weight must be packed into bins. All bins have the same given capacity. A carrier company wants to find the minimum number of bins that can accommodate all items.

Classify the problem, formulate its mathematical model and solve the instance described in the attached file.