Study questions on forecasting

1.

A company produces 2 different pump models. Relevant data on a bottleneck operation in the plant for the upcoming year are given in the table below.

Pump model	Model A	Model B
Demand forecast	45,000 pumps/year	6,000 pumps/year
Lot size	30 units	35 units
Standard processing time	0.2 hour/unit	2.0 hour/unit
Standard setup time	3.0 hours/lot	4.0 hours/lot

The shop works 200 days per year, 2 shifts per day, eight hours per shift, and a 25% capacity cushion is desired. How many machines are needed to meet the upcoming year's demand without resorting to any short-term capacity solutions?
Use the following equation:

$$M = \frac{\{[DP+(D/Q)s]product\ 1+\cdots.+[DP+(\frac{D}{Q})s]product\ n\}}{N[1-(C/100)]}$$

Where: M = number of machines required
D = number of units forecasted per year
P = processing time
N = number of hours per year during which the process operates
Q = Number of units in each lot
C = desired capacity cushion
S = setup time per lot

2.

Give three examples of strategies or processes that the capacity decisions should be closely linked with, and motivate why.

3.

A test rig is able to test engines at an average rate of 8 engines per hour according to a negative exponential distribution. Ready assembled engines arrive at an average rate of 6 per hour, following a Poisson distribution. They are served according to FIFO.

a) Find the following performance measures for this system:
   a. The expected number of engines in the system.
   b. The expected number of engines waiting for service
   c. The expected time in the system
   d. The expected time in the queue
b) Calculate the probability of zero engines in the system.
c) Calculate the probability of more than 0, 1, 2, 3, 4, 5, 6, and 7 engines in the system.

Other excersises can be found in the old exams:

2011-06-09: Q3, Q4, Q12

2011-08-16: Q1, Q10

2012-01-12: Q2, Q4, Q10