# Risk Analysis Assignment 3

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## Group 3

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# Risk Analysis Lab Assignment 3

## Introduction

In this report, we present our solution for the Risk Analysis assignment 3. This assignment is part of the ' *Risk Analysis* ‘course of the ‘*Master’s in Microdata Analysis and Business Intelligence’* program of Dalarna University. For all our coding and simulations we have used R.

## Our Solution

We simulate the operation of a hospital by creating a vector. This vector contains the amount of days each bed of the hospital will be occupied. We then write a loop that simulates each day that passes.

In our code we have 4 stages:

1) In the beginning of each day the counter of occupation days for each bed will be reduced by one.
2) Every bed that is now ‘empty’ (e.g. will be occupied for 0 days) will be removed from the vector. This way the vector will only contain occupied beds.
3) New patients arrive at the hospital
   a) We first simulate the amount of patients which is Poisson distributed by using *new_p <- rpois(1, 14.9)*
   b) We then simulate for each patient the time that he will spend in the hospital which is geometrically distributed, by using *new_beds <- rgeom(new_p, 2.9) + 1*
   c) These new patients will be added to our ‘beds’ vector
   d) If the amount of beds is greater than 40 (the actual number of beds in the hospital) we send those patients to another hospital
   e) We count the amount of patients we take in as ‘serviced’ and the amount we send away as ‘lost’
4) The new patients will be given a new bed and a new day will start

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**1. Assume that currently your hospital has only 40 beds and one bed can serve only 1 patient at a time. Simulate the daily bed occupancy rate (occupied bed/Total bed; max. 1) at your hospital for a period of one year and display the time series.**

To make the system more stable we simulated 465 days and removed the first 100 days from the time series. This is because we started at 0 patients, but in a real life scenario the hospital is already occupied with a number of patients therefore starting at 0 patients would skew our simulation. After doing our simulation, we realize that our worries were unwarranted since the hospital is filled with patients after 4-5 days.

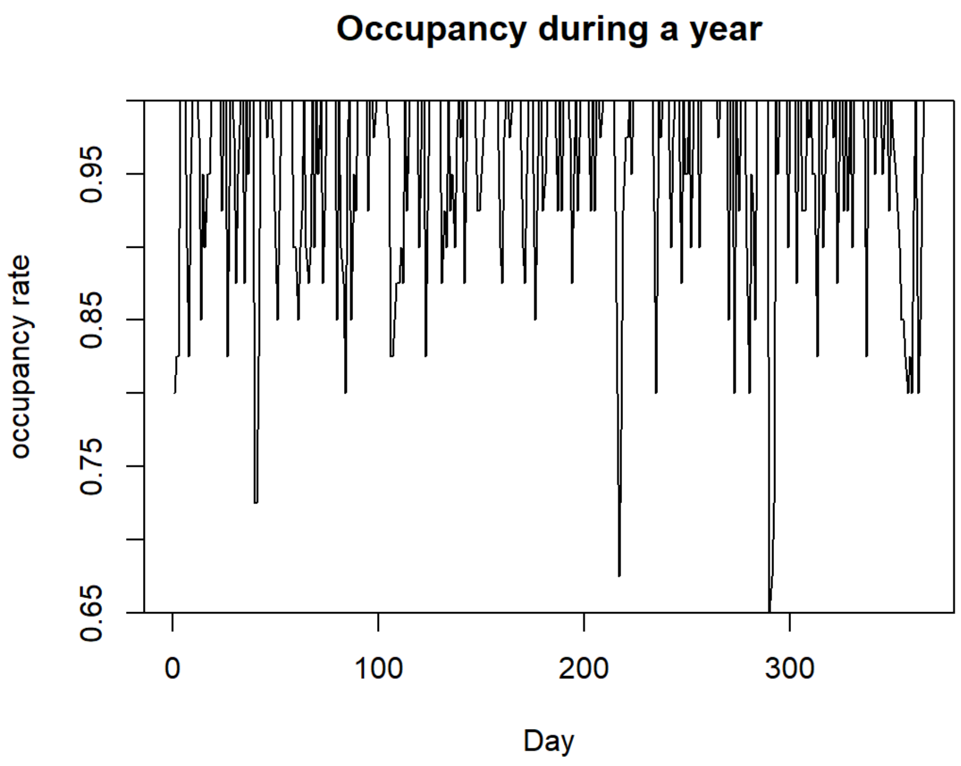


***Figure 1****: Time series of the daily occupation rate over a year.*

**2. What is the probability that a patient coming to this hospital will be sent to another hospital due to unavailability of beds? You may answer the last question by simulating the state of the system over a large number of days (e.g. 10000 days).**

There is the consideration that we need to disregard the first few days until the system stabilizes. From the results of question 1 we know that the system stabilizes after just 4-5 days, which means that we won't end up having skewed results if we simulate 10000 days. After doing the simulation for 10000 days we conclude that **12.3%** of the patients will be sent to another hospital.

**3. What is the required number of beds at the hospital so that the daily bed occupancy rate remains 85% or below with a probability of 0.95 (approximately)?**

We simulate for a different number of beds between 1 and 100 for 100 days, since simulating for more days would take a long time. We investigate which number of beds is closest to the probability of 0.95 and the result is 64 beds.
We simulate 64 beds for 10000 days. We calculate that for 64 beds there is a probability of 0.957 of having an occupancy rate of 85% or below. Simulating 63 beds for 10000 days results in a probability of 0.942 of having an occupancy rate of 85% or below, which is lower than 0.95. Therefore we need **64 beds or more.**