INSTITUTO SUPERIOR DE AGRONOMIA

Applied Operations Research

Monte Carlo Applications to forestry – Exercises

1) Suppose that RAIZ Nursery sells a random number of eucalyptus seedling packs per week and that RAIZ wants to determine a policy for managing the weekly production of seedling packs. Based on their selling history:

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| nr of packs sold / week | weeks |
| 0 | 10 |
| 1 | 20 |
| 2 | 40 |
| 3 | 60 |
| 4 | 40 |
| 5 | 30 |
|  | 200 |

 | 1.1 Simulate the demand of seedling packs for the upcoming 10 weeks considering the following random numbers for the demand: 14, 74, 24, 87, 7, 45, 26, 66, 26, 941.2 Build a graph with the frequencies obtained for the simulated trials in 1.11.3 Extend the simulation of the demand of seedling packs for the upcoming 100 weeks with a set of random numbers of your choice, build a graph with the frequencies and compare with the original distribution and the one obtained in 1.2  |

2) Consider the effectiveness function for a system is **W = 5x + 2y + z** where the variables x, y and z are described by the following probability distributions:



2.1 Assume x, y, z are **independent** and simulate the effectiveness of the system (W) for a series of 18 trials

(*do not use the same random numbers for the different variables (x, y, z) because this might lead to correlation among the variables*)

2.2 Plot the probability distribution of W

3) The gross income per year can be considered to be given by:

**gross income/year = sales/year(D) x selling price/unit (S)**

In general, as the selling price decreases, sales increase (**dependent variables**). Calculate the gross income assuming the distributions below.

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Simulate the gross income for 20 trials. For the first trial consider the random number for sales= 22 and the random number for selling price =73.

4) Suppose you need to prepare inputs to run some eucalyptus simulations using StandsSIM.md simulator. This tool requires information about site index (S), but S estimates are not available for all NFI plots. The data in spreadsheet Ex\_4 shows that only 139 of the 348 plots have been assigned an S value.

Use plots with S to build the distribution of NFI plots by S class and using Monte Carlo simulation assign S values to the remaining plots taking into consideration that S values lower than 8 and greater than 26 will be disregarded. Consider S classes with range=1 (starting at 7.5)

4.1) Do you think of any reason for the high number of even-aged plots without S?

4.2) Do you think of any reason why extreme S values are to be excluded?

4.3) Can you propose an expedite way to analyzing the data you've been provided?

4.4) You have just been informed you will have to simulate the conversion of uneven-aged stands to even-aged stands. What will you do?

5) The AOR students went on a visit to Leiria National Forest where they practiced forest inventory for a whole day. In a stand with 708 trees ha-1 a circular trial plot with 500 m2 was measured. By the end of the day while they were at a local restaurant waiting for dinner they calculated some stand variables such as hdom (10.5 m), basal area (21.8 m2ha-1), the minimum diameter (3.8 cm) and percentile 90 (27.2 cm).

Unfortunately, after a few beers they left the restaurant leaving the field forms with the tree diameters behind. Feeling guilty for the loss they decided to use the Weibull probability density function to simulate the diameter distribution for this stand (considering c=3.6, a=0.9\*dmin, b=(P90-a)/(2.999573^(1/c)).

Assign a diameter to each of the trees in the plot.

6) The demand for paper (units/week) at “The Old Library” shop has a normal distribution with a mean of 200 units per week and a standard deviation of 50 units per week. The lead-time for paper production (weeks) follows an exponential distribution with a mean lead time of one week. Simulate the paper stock at “The Old Library” for 16 weeks assuming that the initial stock is 600 units and that whenever an order is made, 600 units are ordered. The order point is 200 units.

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| demand has a **normal** distribution: N(200,50)lead time has an **exponential** distribution: (1) cost of holding 1 unit (€) = 90cost of making one order (€) = 0.1 | Quantity ordered (units) = 600Order point (units) = 200Initial stock (units) = 600 |

Simulate the stock management for a 16 weeks period

7) Using the data in spreadsheet Ex\_7, that characterize the trees in a trial plot measured in 1981 use the death probability function below to simulate which trees will die:

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|  | Where,  d, is the tree diameter at breast height (cm) gi, is the tree basal area, PI()/40000\*d^2, (m2)g, is the average basal area of the plot (m2) G, is the stand basal area (m2ha-1)  |