Assessment 1: Stochastic systems

Implement a 3x3 discrete square grid. A turtle is placed in the bottom left corner (labelled "1") and moves in discrete time randomly across the square grid. The turtle is constrained to motion into east, west, north and south directions. Label the grid cells of the system like this:

7 8 9
4 5 6
1 2 3

Task 1: Find the transition probabilities between the cells such that the long-term (steady state) probability to be in any cell is the same. Represent the model as a Markov chain diagram (i.e. a directed graph) with the node labels corresponding to the cells numbers above. Label the graph arrows with the transition probabilities. Importantly, write the transition probabilities as fractions (i.e. 1/3) not as floats (i.e. 0.33333).

Deliverable: 1 graph representation. **[3 Marks]**

Task 2: Find transition probabilities between the cells such that the probability to be in the bottom row (cells 1,2,3) is 1/6. The probability to be in the middle row is 2/6. Represent the model as a Markov chain diagram (i.e. a directed graph) with the node labels corresponding to the cells numbers above. Label the graph arrows with the transition probabilities. Importantly, write the transition probabilities as fractions (i.e. 1/3) not as floats (i.e. 0.33333).

Deliverable: 1 graph representation. **[2 Marks]**

For Task 1 & 2 you must use an algorithm/method discussed in the lectures. If you use a different method you must prove that it can work in general.

Task 3: Run the model from task 2 for 3 time steps. Based on 10000 repetitions report the probability and standard deviation that at time step three (that is after three updates) the turtle is at cell 1,3,9.

Deliverable: Report the three numbers in a Table of the following form:

Cell 1	Cell 3	Cell 9
xxx	yyy	zzz

Replacing xxx, yyy and zzz by the relevant probabilities +/- standard deviation (e.g. 0.9 ± 0.01) **[3 Marks]**

Task 4: Run the model from task 2 once, but for a very large number of time-steps (say one million). Report the probabilities and standard deviations for the turtle to be in cell 1,3,9.

Deliverable: A table as in Task 3. **[1 Marks]**

Task 5: Print out the code of your computer program and submit this in printed form along with the rest of the assessment. Feel free to use 8pt font size. **[1 Mark]**

Submit **exactly** 1 side A4 for all of the tasks 1-4 . The code on separate sheets of paper with no page limit. One point deduction if you fail to meet this specification. Submission is to student admin

office on the day of the deadline. For deadline see the relevant SDS page.

Notes on Plagiarism

Senate has agreed the following definition of plagiarism:

"*Plagiarism is the act of repeating the ideas or discoveries of another as one's own. To copy sentences, phrases or even striking expressions without acknowledgement in a manner that may deceive the reader as to the source is plagiarism; to paraphrase in a manner that may deceive the reader is likewise plagiarism. Where such copying or close paraphrase has occurred the mere mention of the source in a bibliography will not be deemed sufficient acknowledgement; in each such instance it must be referred specifically to its source. Verbatim quotations must be directly acknowledged either in inverted commas or by indenting.*"

The work you submit must be your own, except where its original author is clearly referenced. We reserve the right to run checks on all submitted work in an effort to identify possible plagiarism, and take disciplinary action against anyone found to have committed plagiarism. When you use other peoples' material, you must clearly indicate the source of the material.