1. There are two stoks on the market, stock A and stock B. Every day the price of stock A will either increase by 1 dollar with probability 0.6 or decrease by one dollar with probability 0.4. Similarly stock B will either increase by 2 dollars with probability 0.55 or decrease by two dollars with probability 0.45.

   a) If, at the beginning, the prive of stock A was 100 dollars and that of stock B was 120 dollars, what is the (approximate) price distribution of stock A and B after 100 days?

   b) Compute the probability that, after 100 days, the price of stock A will be less than than its initial price. Do the same for stock B.

   c) At the beginning you have 20000 dollars and you buy 140 stock A and 50 stock B. What is the probability that after 100 days you have lost money? Doubled your initial capital?

2. A circuit is composed by two devices, A and B, connected in parallel (see figure).
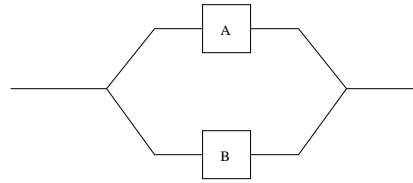
   You know that the circuit fails if both devices fail and that each device has a exponential life time with parameter λ, this means that if T_A and T_B are the r.v. describing the lifetime of device A and B respectively then both T_A and T_B are exponential r.v. with parameter λ.

   a) Find the p.d.f. of the lifetime T of the circuit.

   You observe the lifetime of 10 such circuits and obtain the following breacking-down times:

   3.47 1.69 1.78 0.45 1.60 3.91 2.81 7.66 0.72 2.32

   A) Use the method of moments to give an estimate of λ.

   B) Use the method of maximum likelihood to estimate λ.

   C) The half live of the circuit is defined as that time when, starting with a big set of circuit, only half of them are still working. Give an estimate of the half life of the circuit using the invariance principle.

3. **(Bonus)** The following data come from a population uniformly distributed between $-A$ and A:

   -0.255 0.915 -0.185 -0.363 0.508 -0.559 1.436 1.013 1.251 -0.539

   a) Use the method of moment to estimate A.

   b) Use maximum likelihood to estimate A.

4. Among the sudent that attempted the exams of Calculus III (CIII) and Differential Equation (DE) is oberved that the joint probability of passing or failing the exams is given by the following table:

		CIII	
		f	p
DE	f	0.3	0.1
	p	0.1	0.5

This means, for example, that the probability for a student to pass both exams is 0.5 while the probability of passing DE and failing CIII is 0.1. Given a student, let X be the r.v. that describes his result in DE and Y the r.v. that describes his result in CIII. Both variables take value 0 or 1 where 0 mean fail and 1 pass.

a) Compute the marginals $f_X(x)$, $f_Y(y)$.

b) Compute the conditional p.d.f. $f_{X|Y}(x|y)$ and $f_{Y|X}(y|x)$.

c) Compute $\text{Corr}(X,Y)$.

d) Suppose now that you choose 3 students at random and let N_X the number of students among the 3 that passed DE and N_Y the number of students among the 3 that passed CII. Compute the probability that $N_X = 1$ and $N_Y = 2$.