

1. Consider the dynamical system

$$u(n) = 0.3u(n-1) - 0.5v(n-1) + 30$$

$$v(n) = 0.2u(n-1) + v(n-1) - 4$$

- (a) Find the equilibrium point.

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The equilibrium point for  $(u, v)$  is  $(20, 32)$ .

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- (b) Does the equilibrium point appear to be stable or unstable? Show enough work to justify your answer.

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n	u(n)	v(n)	n	u(n)	v(n)	n	u(n)	v(n)	n	u(n)	v(n)
0	8	14	0	12	96	0	82	0	0	213	147
5	30.889	20.173	5	-10.288	64.038	5	25.495	27.443	5	-68.925	130.550
10	24.031	27.939	10	9.211	42.844	10	21.337	30.692	10	-13.894	66.195
15	21.335	30.664	15	16.437	35.564	15	20.424	31.577	15	8.745	43.264
20	20.438	31.562	20	18.832	33.168	20	20.138	31.862	20	16.307	35.693
25	20.144	31.856	25	19.617	32.383	25	20.045	31.955	25	18.790	33.210
30	20.047	31.953	30	19.875	32.125	30	20.015	31.985	30	19.603	32.397
35	20.015	31.985	35	19.959	32.041	35	20.005	31.995	35	19.870	32.130
40	20.005	31.995	40	19.987	32.013	40	20.002	31.998	40	19.957	32.043
45	20.002	31.998	45	19.996	32.004	45	20.001	31.999	45	19.986	32.014
50	20.001	31.999	50	19.999	32.001	50	20.000	32.000	50	19.995	32.005

The equilibrium point  $(20, 32)$  appears to be stable.

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2. Suppose the population of a town is currently 800, and it is growing by 20 people per year. Let  $u(n)$  represent the population of this town  $n$  years from now.

- (a) Find a discrete dynamical system along with an initial value for  $u(n)$ .

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$$u(n) = u(n-1) + 20$$

$$u(0) = 800$$


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- (b) Find an explicit formula for  $u(n)$ .

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$$u(n) = 20n + 800$$


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3. Suppose the population of a town is currently 600, and it is growing by 5% per year. Let  $u(n)$  represent the population of this town  $n$  years from now.

(a) Find a discrete dynamical system along with an initial value for  $u(n)$ .

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$$u(n) = 1.05u(n - 1)$$

$$u(0) = 600$$

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(b) Find an explicit formula for  $u(n)$ .

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$$u(n) = 600(1.05)^n$$

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