(don't judge my spelling) ☺ 4/29/16

Practice Exam

#3)

acceleration

5000m

↓ $a = -10 m/sec^2$

derivative of velocity is acceleration

(a) $\frac{dV}{dt} = a = -10$

(b) $V(t) = -10t + C$

$V(0) = 0 = -10 \cdot 0 + C \Rightarrow C = 0$

So: $V(t) = -10t$

(c) $\frac{dp}{dt} = V = -10t$

derivative of position is velocity

$p = \int V\,dt = \int -10t\,dt = -10\int t\,dt = -10\,\frac{t^2}{2} + C$

$\Rightarrow -5t^2 + C$

$p(t) = -5t^2 + C$

$p(0) = -5 \cdot 0^2 + C = 5000 \Rightarrow C = 5000$

So: $p(t) = -5t^2 + 5000$

(d) & (e) ← decrease acceleration (drag)

$\frac{dV}{dt} = -10 - 0.5V$

→ units of pure time 1/time

(f) $\frac{dV}{dt} = 0 = -10 - 0.5V^*$

$10 = -0.5V^*$

$\frac{10}{-0.5} = V^* \Rightarrow -20$ m/sec

$\frac{dV}{dt} = -10 - 0.5V$

$V^* = -20$

is it stable?

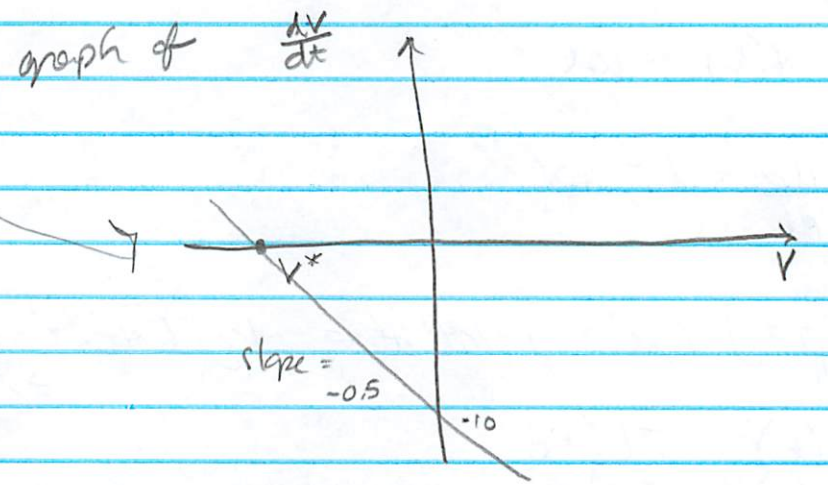
Method 1: Equilibrium is stable if slope of rate of change function is negative (graph goes down) at equilibrium

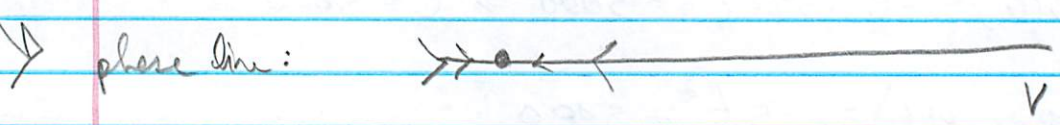
yes - slope is -0.5 - so it is stable

Method 2: Draw phase-line

Arrows point toward equilibrium

yes - it is stable





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Practice Exam

Data

#4)

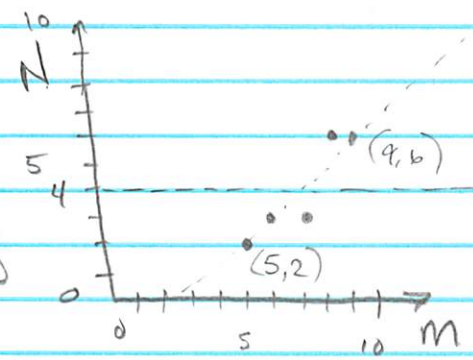
Males	Melodiocity	# of Females Impressed
A	5	2
B	8	6
C	7	3
D	6	3
E	9	6

(a) Null hypothesis: that there is no relationship of melodiocity and # females

(b) give things names! M = Melodicity N = females impressed

$N = aM + b$ is linear model

(c) graph it first, before guessing



pick 2 points find slope

slope = $\frac{\text{change in } Y}{\text{change in } X}$

$= \frac{\Delta Y}{\Delta X}$

slope $= \frac{6-2}{9-5} = 1$

$a = 1, \quad b = -3$

$N = M - 3$

$N = 1 \cdot M - 3$

find intercept by using point-slope form:

$[y = m(x - x_1) + y_1]$

$N = 1 \cdot (M - 5) + 2$

$= M - 5 + 2$

$N = M - 3$

$[y = mx + b]$

$\bar{N}$ = average of N

$\frac{2+6+3+3+6}{5} = 4$

4)

re-written data → use linear model from ⓒ $N = m - 3$

ⓓ

Male	Molarity M	Data N	$\hat{N}$	ε	ε^2	$\hat{N}_{Null}$	ε_{Null}	ε^2_{Null}
A	5	2	2	0	0	4	-2	4
B	8	6	5	1	1	4	2	4
C	7	3	4	-1	1	4	-1	1
D	6	3	3	0	0	4	-1	1
E	9	6	6	0	0	4	2	4
					$2 = SSE$			$14 = SST$

$r^2 = 1 - \frac{SSE}{SST} = 1 - \frac{2}{14} = \frac{12}{14} = \frac{6}{7}$

to find SST, use line $N = \bar{N} = 4$

ⓔ - use R, look in a book, take another statistic class, etc...

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Practice Exam

#5)

VWTFD = Virginia's Warbler-Tracking Flying Dogs

Let S = singing Q = quiet (silent)
L = located N = not located

Prob. singing bird observed by human = 0.9
Prob. quiet (silent) bird observed by human = 0.3
Prob. of singing 1/3

$Pr(L|S) = 0.9$
$Pr(L|Q) = 0.3$
$Pr(S) = 1/3$
$Pr(Q) = 2/3$

Uses Bayes Theorem:

$$Pr(S|L) = \frac{Pr(L|S) \cdot Pr(S)}{Pr(L)} = \frac{0.9\,(1/3)}{0.5} = \frac{0.3}{0.5} = 0.6$$

Total Law of Probability

$$Pr(L) = Pr(L|S)Pr(S) + Pr(L|Q) \cdot Pr(Q)$$
$$= (0.9)(1/3) + (0.3)(2/3)$$
$$= 0.3 + 0.2$$
$$Pr(L) = 0.5$$

$$Pr(S \text{ and } L) = Pr(L|S)\,Pr(S) = 0.3$$

Joint Distribution of observed data.

	birds S	birds Q	
L (by human)	0.3	0.2	→ 0.5
N	0.033 ↓ 0.333	0.467 ↓ 0.667	→ 0.5

} this joint is not independent

(b) Table of data on 90 birds (multiple by 90)

observed

	S	Q	
L	27	18	→ 45
N	3	42	→ 45
	↓	↓	
	30	60	

27 is from multiply (0.3)(90) .... repeat for other values

(c) Under null hypothesis, singing birds are not easier to locate.

Think about how the prob would be if joint distribution is independent (joint is product of marginals)

	S	Q	
L	1/6	1/3	→ 1/2
N	1/6	1/3	→ 1/2
	↓	↓	
	1/3	2/3	

You could then use χ^2 test of observed & Expected

Data if no relationship: ← this would be the "Expected" numbers if null hypothesis is true

	S	Q
L	15	30
N	15	30

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$$\chi^2 = \frac{(27-15)^2}{15} + \frac{(18-30)^2}{30} + \frac{(3-15)^2}{15} + \frac{(42-30)^2}{30}$$