L22

4800

11.29.2016

abhi shelat

Apple Inc. (AAPL)

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NasdaqGS - NasdaqGS Real Time Price. Currency in USD

111.57 -0.22 (-0.20%)

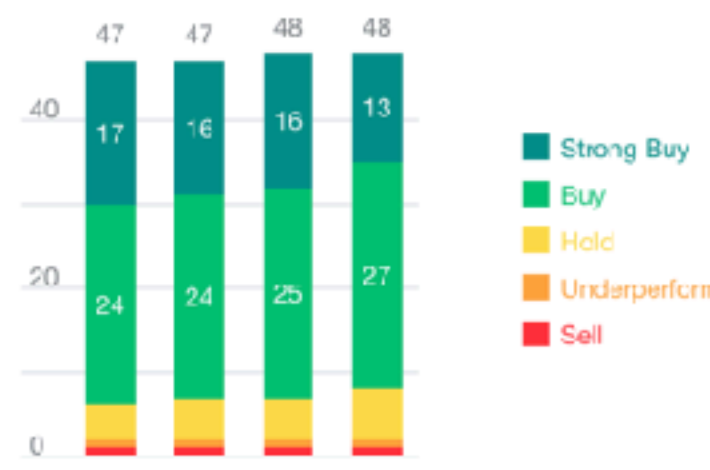
At close: November 28 4:00 PM EST

110.85 -0.72 (-0.65%)

Pre-Market: 9:14AM EST

Earnings Estimate	Current Qtr.	Next Qtr.	Current Year	Next Year
No. of Analysts	36	36	42	35
Avg. Estimate	3.22	2.18	9.05	10.09
Low Estimate	3.04	1.94	8.05	8.24
High Estimate	3.77	2.44	10.01	12.12
Year Ago EPS	3.28	1.9	8.31	9.05

Recommendation Trends ›



Analyst Firms Making Recommendations

- ACCOUNTABILITY
- B OF A M L
- BAIRD R W
- BREAN CAPITAL
- CLSA AMERICAS
- COWEN & COMPANY
- DEUTSCHE BK SEC
- EDWARD JONES
- J.J.B.HILLIARD
- JP MORGAN SECUR
- MORGAN STANLEY
- OPPENHEIMER HLD
- PACIFIC CREST
- PIPER JAFFRAY
- RAYMOND JAMES
- STIFEL NICOLAUS
- WELLS FARGO SEC
- WILLIAM BLAIR

Suppose the expert model gives us a "buy/sell" rating at the beginning of of every day. We will sell our position at the close of every day. They are correct if their recommendation makes us money.

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Given n expert opinions for T days,
can we devise a strategy that performs almost as well as the BEST expert *in hindsight*?

Weighted Majority (1)

1. All experts begin with weight $w^0(e) = 1$.

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$$w^t(e) \leftarrow (1\text{-epsilon})\ w^{t-1}(e)$$

Weighted Majority

	Weight W_0	Recs	Action
Expert 1	1		
Expert 2	1		
Expert 3	1		
	…		
Expert 4	1		

Weighted Majority

	Weight W_0	Recs	Action
Expert 1	1	"Buy"	
Expert 2	1	"Buy"	
Expert 3	1	"Sell"	
…			
Expert 4	1	"Buy"	

Weighted Majority

	Weight W_0	Recs	Action
Expert 1	1	"Buy"	3 buys, 1 sell —> BUY
Expert 2	1	"Buy"	
Expert 3	1	"Sell"	
...			
Expert 4	1	"Buy"	

Weighted Majority

	Weight W_1	Recs	Action
Expert 1	1		
Expert 2	1		
Expert 3	0.5		
	…		
Expert 4	1		

Weighted Majority

	Weight W_1	Recs	Action
Expert 1	1	"Sell"	
Expert 2	1	"Sell"	
Expert 3	0.5	"Sell"	
...			
Expert 4	1	"Buy"	

Weighted Majority

	Weight W_1	Recs	Action
Expert 1	1	"Sell"	2.5 Sell, 1 Buy —> SELL
Expert 2	1	"Sell"	
Expert 3	0.5	"Sell"	
…			
Expert 4	1	"Buy"	

Thm: After T days, let $m_i^{(T)}$ be number of times *i* was wrong and let M(T) be the number of times our strategy was wrong. Then

$$M^{(T)} \leq 2(1+\epsilon)m_i^{(T)} + \frac{2\ln n}{\epsilon}$$

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Our strategy makes roughly 2x + additive more mistakes than the best expert.

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Proof:

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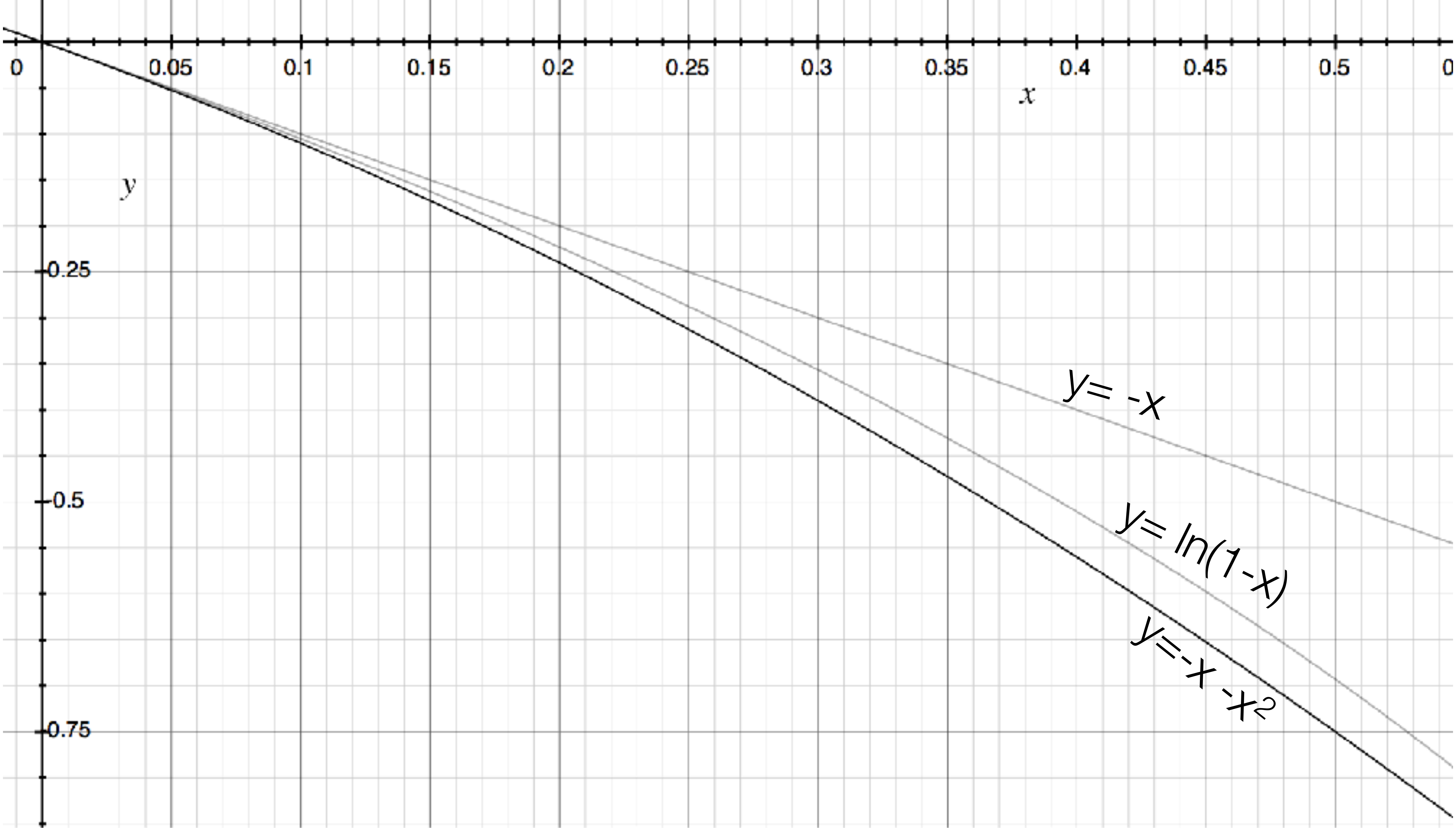
Proof: $(1-\epsilon)^{m_i^{(T)}} \leq \phi^{(T)} \leq n \cdot (1-\epsilon/2)^{M^{(T)}}$



0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
x
y
0.25
0.5
0.75
y= -x
y= ln(1-x)
y=-x -x2

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Proof:

$$(1-\epsilon)^{m_i^{(T)}} \leq \phi^{(T)} \leq n \cdot (1-\epsilon/2)^{M^{(T)}}$$

$$M^{(T)} \leq m_i^{(T)} \frac{\ln(1-\epsilon)}{\ln(1-\epsilon/2)} - \frac{\ln(n)}{\ln(1-\epsilon/2)}$$

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Can we do better than 2x?

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Can we do better than 2x?

Unfortunately, this deterministic strategy can't do better than 2x.

Weighted Majority (1)

A

1. All experts begin with weight $w^0(e) = 1$.

2. Repeat for all timesteps:

   Query each expert. Take weighted average as final action.

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   $$w^t(e) \leftarrow (1\text{-epsilon})\, w^{t-1}(e)$$

Imagine an adversarial stock ADV.

Consider two experts, Opt: always buy, Pess: always sell.

At every timestep, ADV does the opposite of what A recommends.

After t steps, one of our experts will be incorrect at most t/2 times.

After t steps, our strategy will be incorrect t times!

Solution: randomize!

Random Weighted Majority

1. All experts begin with weight $w^0(e) = 1$.

Randomly sample expert j with Pr $\rho_j = w_j^{(t-1)} / \phi^{t-1}$

Do what your sampled expert would do.

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   $w^t(e) \leftarrow (1\text{-epsilon})\, w^{t-1}(e)$

Thm 2: After T days, let $m_i^{(T)}$ be number of times *i* was wrong and let M(T) be the number of times our strategy was wrong. Then

$$M^{(T)} \leq (1+\epsilon)m_i^{(T)} + \frac{\ln n}{\epsilon}$$

Need to show: $\Phi^{(T)} \leq ne^{-\epsilon M^{(T)}}$

$$a_i^{(t)} = \begin{cases} 1 & i \text{ is wrong} \\ 0 & \text{otherwise} \end{cases}$$

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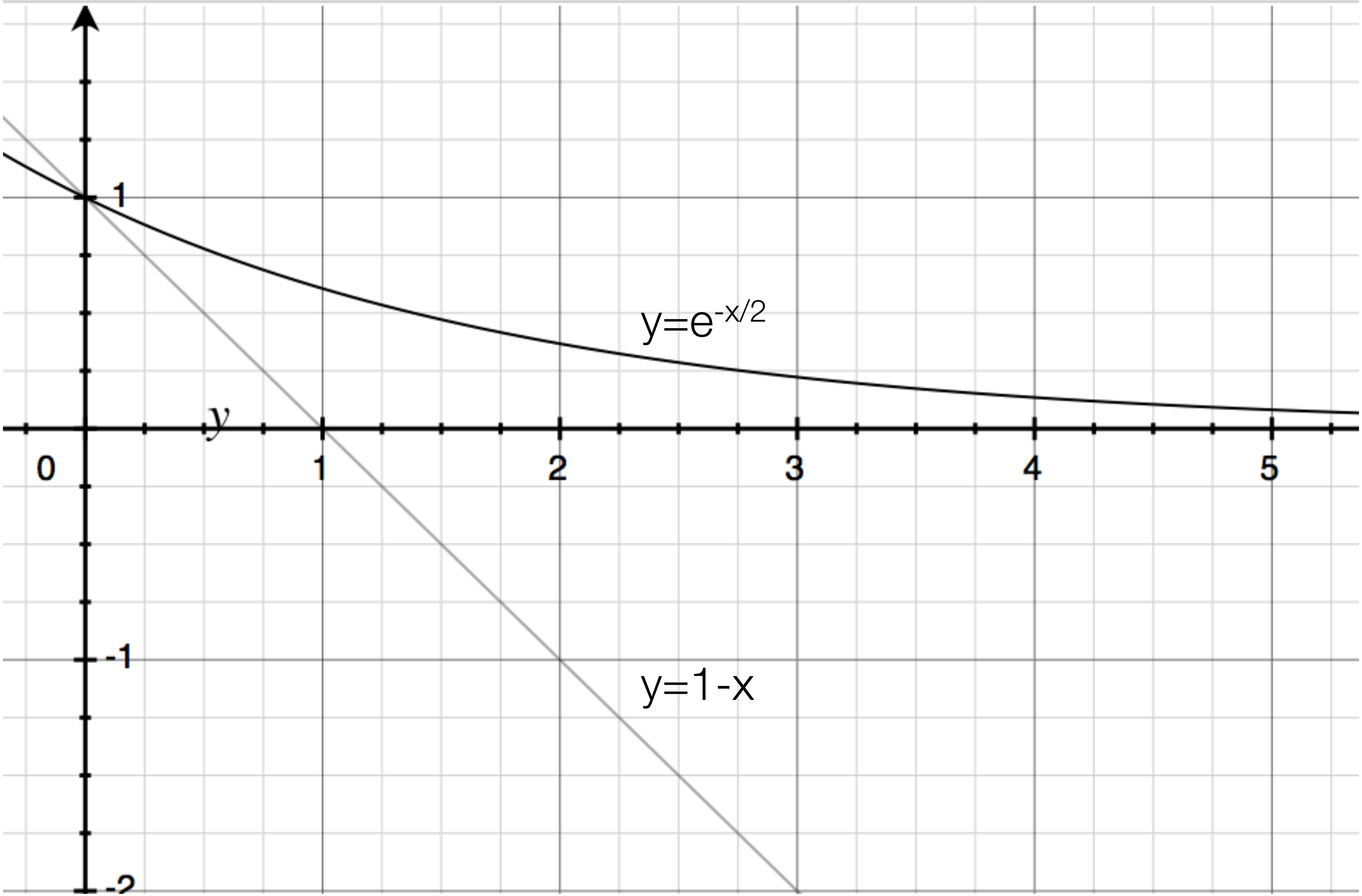
$$a_i^{(t)} = \begin{cases} 1 & i \text{ is wrong} \\ 0 & \text{otherwise} \end{cases}$$

$$b^{(t)} = \frac{\sum a_j^{(t)} w_j^{(t)}}{\Phi^{(t)}}$$

Pr that we make mistake @ t



1
y=e^{-x/2}
y
0
1
2
3
4
5
-1
y=1-x
-2