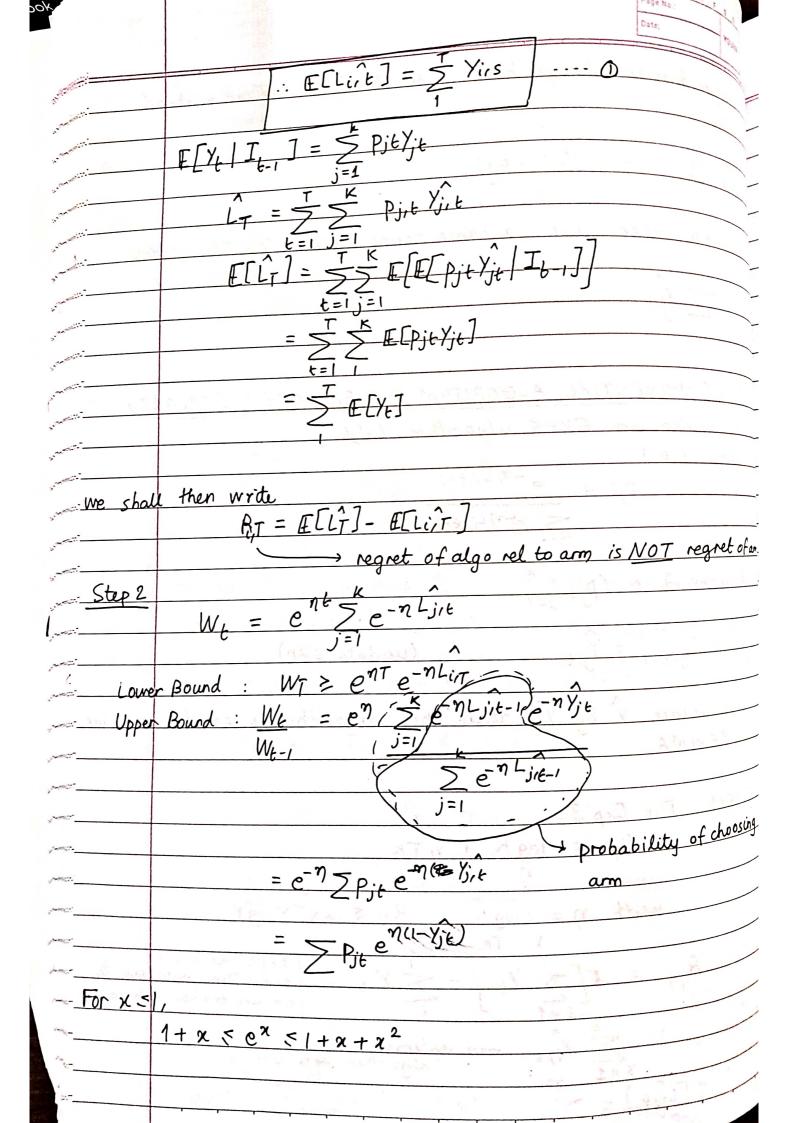
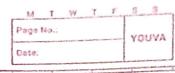
\		E. D. T. Mark Committee Care A.	
/ /	55610	6 Lecture 4 (Date: 23 January 2024)	—
	Adver	sarial Bandits	—, —,
	The infa	omation table can be written as an array of the form	—, —,
1		y = y, y  ! y, T We are not assuming	
1		y kil Ykit any kind of underlying distribution for the losse	44
		CMS(1710000) 101 1182 1055C	<u></u>
		loss of expert lam i	
		at time T	
			, ·

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Malgorithm does not always have access to Yit so we can instead Yje (1- Pje) variance tends to be QUITE LARGE Jit = Sit EXP3 (EXPONENTIAL ALGORITHM FOR EXPLORE & EXPLOIT) an EXP4 algorithm, bol) At time t > Pick arm At ~ (Pit (update step) -j, t-1 + Y), t If we replace I by Y, then this algorithm is exactly similar to REWMA For Exp 3, THEOREM RT < log K + nTK RT = 2 VTKlog K log K Expected loss of algorithm relative to an arbitrarily selected am PROOF =  $\frac{t}{\sqrt{i}}$   $\frac{t}{\sqrt{i}}$  estimate of loss of algorithm upto arm i Step 1

E[Lift] = E[E/ E[Yis | Is=1





$$\frac{W_{t}}{W_{t-1}} \leq \frac{\sum P_{jt} (1+\eta)(1-y_{jt}^{2})+\eta^{2}(1-y_{jt}^{2})^{2}}{W_{t-1}}$$

WE-1

summation is wit

the index of arms {1,..., k}

$$\frac{W_{\tau}}{K} = \frac{T}{W_{t-1}} \frac{W_{t}}{W_{t-1}} = e^{\eta \sum \sum P_{jt} (1-\hat{Y_{jt}}) + \eta^{2} \sum \sum P_{jt} (1-\hat{Y_{jt}})^{2}}$$

call this N

Combining the LB & UB, we have 
$$e^{\eta T}e^{-\eta L_i \hat{T}} \leq K | N | \leq \epsilon p_j t$$
  $\leq \epsilon p_j t$   $\leq \epsilon p_j t$ 

$$T - L_{i,T} \leq \log K + T - L_{T} + \eta \leq \sum_{\ell=1}^{\infty} \frac{1}{j^{\ell}}$$

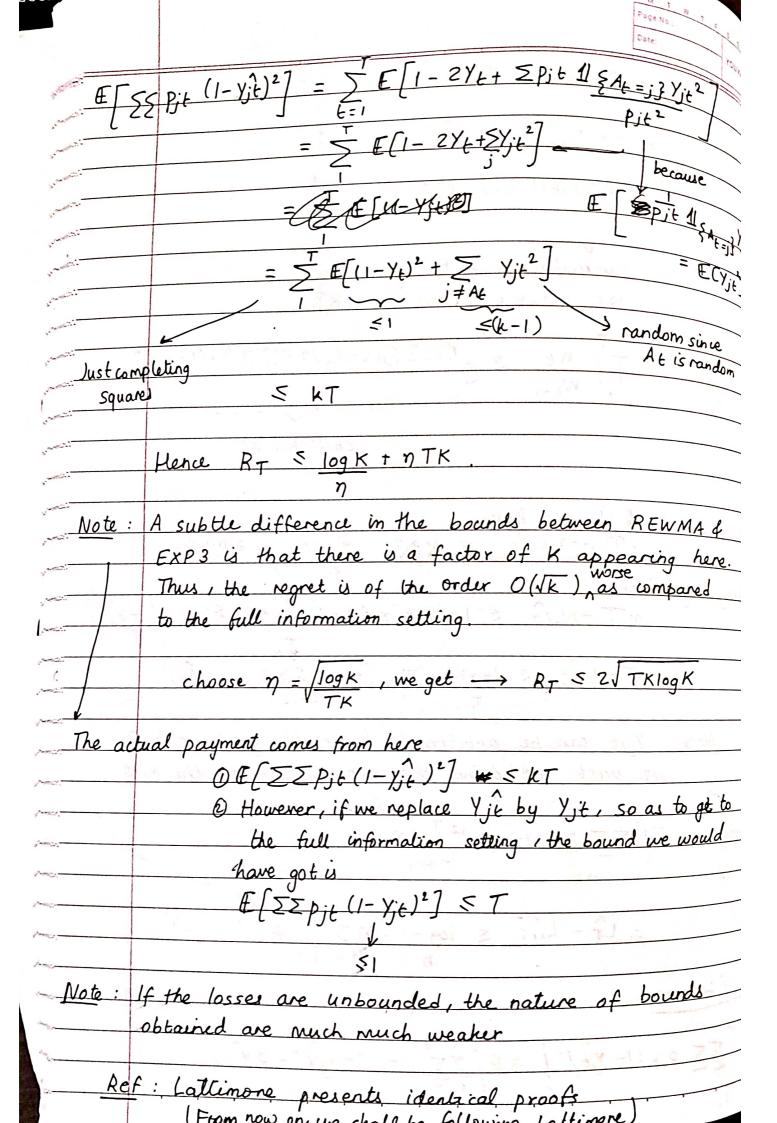
Note: Yit can be arbitrarily large though Yit & [0,1] we wish to bound the expectation on the RHS

hemma: 
$$\mathbb{E}\left\{\sum \sum p_{jt}(1-\hat{y_{jt}})^{2}\right\} \leq kT$$

$$\frac{1}{2} \cdot L_{T}^{2} - L_{i,T}^{2} \leq \frac{\log K + \eta}{\eta} \sum_{t=1}^{\infty} \frac{1}{j-1} \left(1 - \gamma_{j,t}^{2}\right)^{2}$$

Proof of hemma.

$$\mathbb{E}\left[\sum_{i=1}^{k}\frac{1-y_{i}^{2}}{1-y_{i}^{2}}\right]=\mathbb{E}\left[\sum_{i=1}^{k}\frac{1-y_{i}^{2}}{1-y_{i}^{2}}\right]$$



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The high probability bounds for the regrets obtained in this algorithm are quite bad. There exists a refined algorithm for this called the Exp3-IX