Selling Futures Online Advertising Slots via Option Contracts

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§1 Motivation

Affected by the dual force of supply and demand, the agreed prices of an online ad slot often exhibit abrupt and extreme changes over time (see Figure 1). This makes the cost of displaying ad slots (for advertisers) and the advertising incomes (for publishers and search engines) unpredictable. Thus there are increasing needs of a new advertising trading mechanism to manage the risk of cost or income.

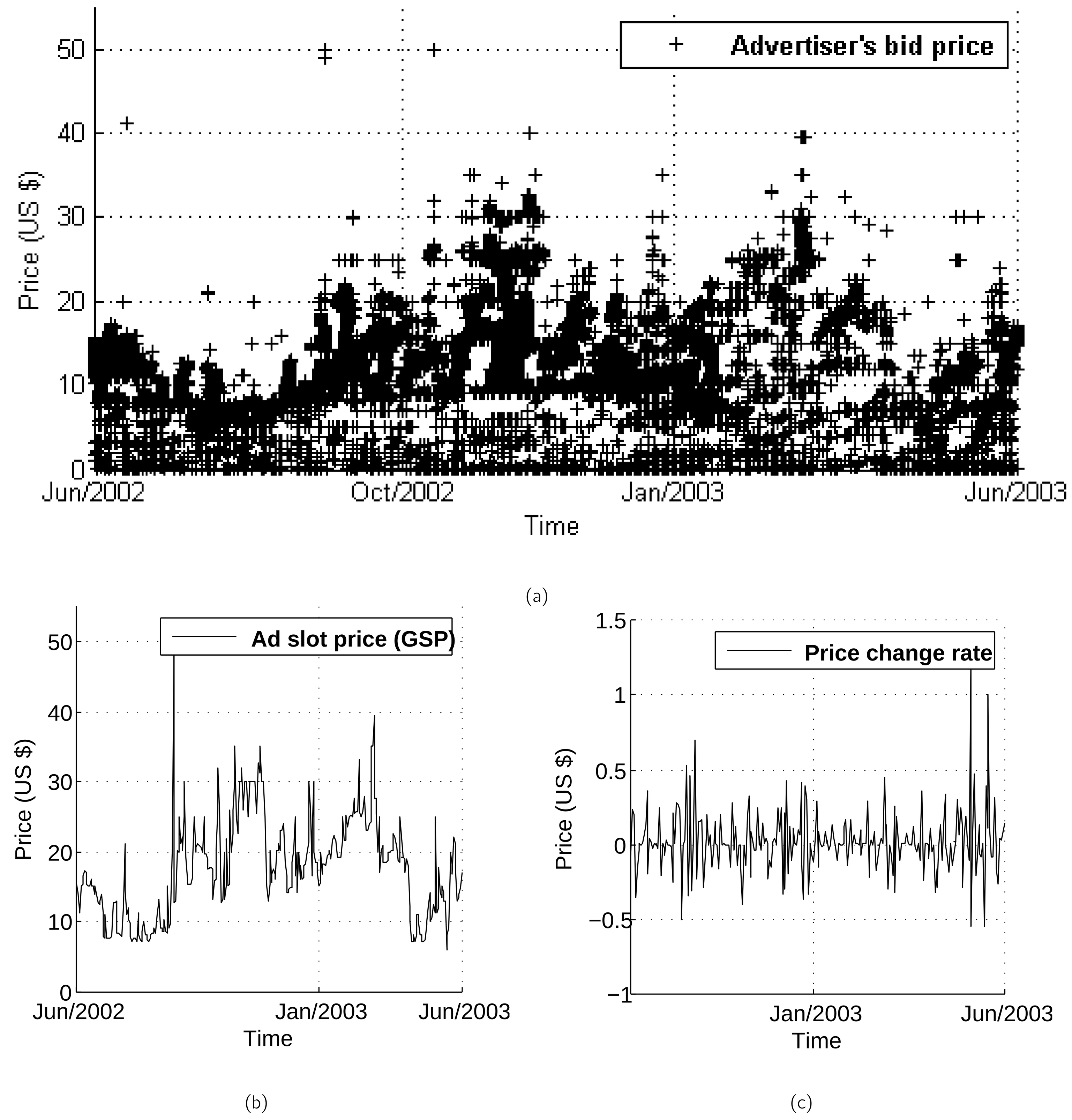

Figure 1: Plots of a selected Yahoo! online advertisement from 2002 to 2003: (a) advertisers' bidding prices; (b) accepted generalized second-prices (GSPs); (c) change rates of the GSPs.

§2 Ad Option and Its Pricing

An **Ad Option** is defined as a contract signed by advertisers and publishers or search engines. The ad option can give its buyer (normally advertisers) the right to buy a certain amount of advertising impressions or clicks from its seller (normally publishers or search engines) in the future time at a prefixed price. The ad option buyer needs to pay its seller an upfront fee at the current time, called **Ad Option Price**.

There are two benefits of the ad option contract: 1) it is a new advertising trading mechanism that bridges the spot and the future markets together; 2) it can help advertisers, publishers and search engines to manage their future cost and incomes smoother, less volatile and be easier to predict.

A key question is:"How much of an ad option price should be?" Let us consider an example of ad option pricing for impression-based ad slots. In the future time, assume there are total M impressions to sell and two movement directions of ad slot price, say, $A^u_{t+\Delta t}$ and $A^d_{t+\Delta t}$. The publisher would like to sell αM impressions via ad options and sell $(1-\alpha)M$ impressions on the spot markets.

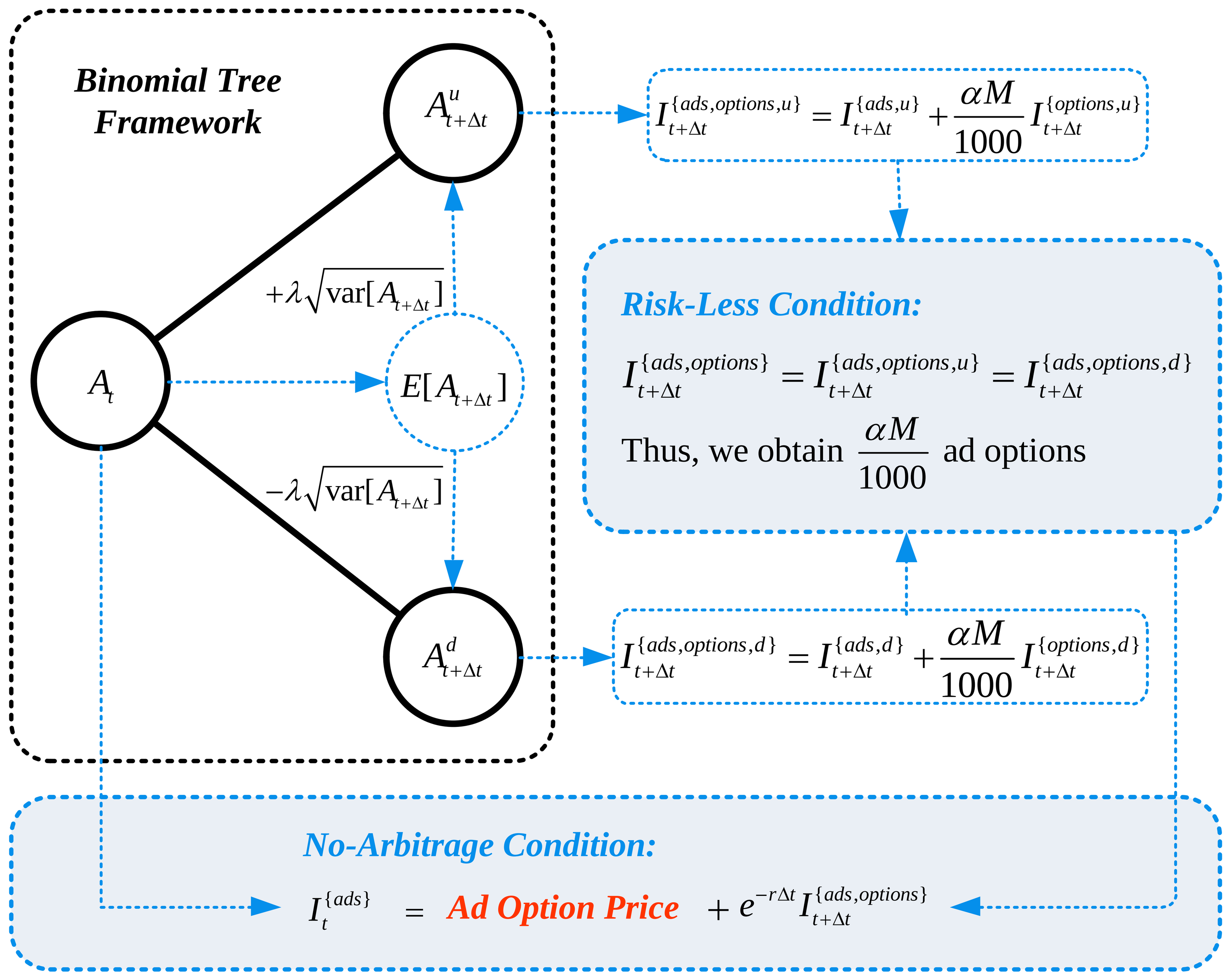

Figure 2: The binomial tree framework for the ad slot price movement.

The future ad slot price can be estimated from forecasting models, i.e. $E(A_{t+\Delta t})$ and $\mathrm{var}(A_{t+\Delta t})$, where λ in the Figure 2 is an estimation parameter. The future incomes of publisher are assumed to be risk-less. That is, we let the upside and downside incomes equal and obtain the number of the ad options to sell. To avoid the arbitrage, the future advertising income is expected to be at least equal to the current income from the spot markets. Based on that we then obtain the fair ad option price.

§3 Experiments and Conclusion

In the experiments we have used Yahoo! online advertising dataset and have investigated Geometric Brownian motion and mean-reverting process to describe the movement of ad slot prices. Figure 3 shows that $\lambda = 1.3$ gives the smallest mean value of RMSEs, so we choose it as the optimal default value. Table 1 then illustrates clearly that the publisher's risk is reduced substantially when he increases the number of ad options from zero to the number of ad options suggested by the pricing model ($\alpha M/1000$).

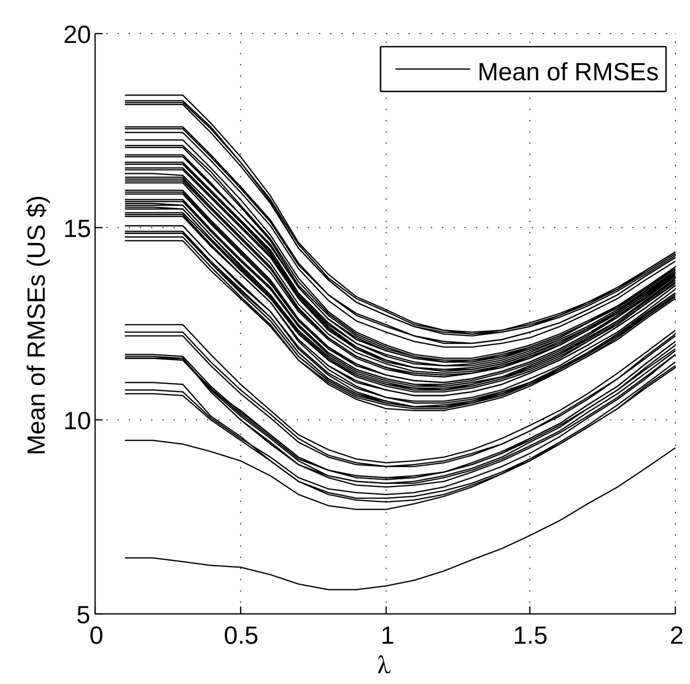

Figure 3: The impact of parameter λ on the accuracy of estimated ad option prices.

Table 1: Risk vs. reward of a Yahoo! online ad.

Time	0 options	$\frac{1}{2}\frac{\alpha M}{1000}$ options	$\frac{\alpha M}{1000}$ options
5	294.6 (116.5)	263.2 (67.2)	231.8 (18.9)
10	313.3 (104.4)	284.2 (60.2)	255.2 (32.4)
30	334.8 (127.9)	301.9 (87.9)	269.0 (57.9)
60	333.0 (122.1)	305.9 (81.3)	278.9 (52.7)

Note: the figures out of the brackets are the expectations while those in the brackets are the standard deviations.