

## Question 1

- (a) The price paying to the seller of each possible pairs is shown in Table 1. Therefore, the seller's expected revenue is  $0 \times \frac{1}{4} + 0 \times \frac{1}{4} + 0 \times \frac{1}{4} + 1 \times \frac{1}{4} = \frac{1}{4}$

Table 1: Price paying to the seller

	$v_2 = 0$	$v_2 = 1$
$v_1 = 0$	0	0
$v_1 = 1$	0	1

- (b)  $(0 \times C_0^3 + 0 \times C_1^3 + 1 \times C_2^3 + 1 \times C_3^3)/8 = \frac{1}{2}$
- (c) The seller's revenue is 1 only if the number of bidders having values of 1 is greater than or equal to 2. As the number of bidders grows, the probability of having this situation becomes larger and that causes the seller's expected revenue converges to 1.

## Question 2

- (a) The valuation for x is 24, 20, 6.  
The valuation for y is 12, 10, 2.  
The valuation for z is 6, 5, 1.  
  
The optimal allocation is assigning  
slot a to x for  $(12 - 10) + (5 - 1) = 6$ .  
slot b to y for  $(5 - 1) = 4$ .  
slot c to z for 0.
- (b) The optimal allocation using GSP auctions is assigning  
slot a to x for  $6 \times 2 = 12$ .  
slot b to y for  $5 \times 1 = 5$ .  
slot c to z for  $1 \times 0 = 0$ .

### Question 3

- (a) Buyer a wins the auction since buyer a is the highest bidder, and buyer a will pay the second highest bid which is 3.
- (b) buyer a receives item x for  $(3 - 0) = 3$ .  
buyer b receives item y for  $(0 - 0) = 0$ .  
buyer c receives item z for 0.  
Because by doing this, VCG procedure makes a socially optimal allocation of items, and truth telling becomes a dominant strategy in VCG procedure.

### Question 4

- (a) One advantage is that TrackMeNot (TMN) obfuscates users' actual searches without interfering users searching procedure because it runs in background. The limitation is that some decoy searches it generated do not like human-generated queries. Text below is from TMN's paper and some of the queries just look strange. These queries can be distinguished easily using machine learning techniques. Possible way to improve is that the query-lists can be collected from the top queries from Google Trend, and at the substitution step, extracting substitute queries using text from relative queries instead of the whole HTML.

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- (b) The straightforward solution is blocking third-party cookies in the browsers. By doing this, the information is restricted to the first-party websites, and it is hard to track users across websites.