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Secondary user pricing strategies in a cognitive radio environment

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%--------------------Elicia Naidu---------------------%
%------------Secondary User Pricing Strategies--------%
%------------------Pricing Comparison-----------------%

clc
clear all
close all;


Wi = 20;
M = [10 10];
BER_tar = 10^(-4);
B_req = 3;
c1 = 5;
c2 = 10;
SNR = 10;
v = 0.7;
N = 2;


%p = transpose([0.25 10]);
b = [2 15];
market_price = 0;


K = 1.5/(log(0.2/BER_tar));
k_secondary = log2(1+(K*SNR));
k_primary = log2(1+(K*SNR));


Col = ['r', 'b', 'g', 'k','c', 'm', 'y'];
Mark = ['s', 'x', 'd', '*'];
total_market_profit_y = [ ];
total_competitive_profit_y = [ ];

for i = 1:1

    price2_x = [ ];
    county = 1;
    p = [ ];
    market_profit_y = [ ];
    competitive_profit_y = [ ];
    competitive_profit_derivative_y = [ ];
    primaryusers_profit_y = [ ];


    for price2 = 0:0.5:10

        price1_x = [ ];
        price2_x = [price2_x price2];
        countx = 1;
        market_profit_x = [ ];
        competitive_profit_x = [ ];
        primaryusers_profit_x = [ ];
        competitive_profit_derivative_x = [ ];

        for price1 = 0:0.5:10
            p = [price1 price2];
            price1_x = [price1_x price1];
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            %             P1 = p(i)*((2*c2*(k_primary^2))/(M(1)*((1-v^2)^2))
+ 2/(1-v^2)) + ((p(j)*v)/(1-v^2))*(1+((2*c2*(k_primary^2))/(M(1)*((1-
v^2)^2)))) + ((k_secondary - v*k_secondary)/(1-v^2) +((2*c2*k_primary)/(1-
v^2))*(B_req - (k_primary*Wi)/M(1) + (k_primary*k_secondary)/((1-v^2)*M(1)) -
(k_primary*k_secondary*v)/((1-v^2)*M(1))));
            %             P2 = p(j)*((2*c2*(k_primary^2))/(M(2)*((1-v^2)^2))
+ 2/(1-v^2)) + ((p(i)*v)/(1-v^2))*(1+((2*c2*(k_primary^2))/(M(2)*((1-
v^2)^2)))) + ((k_secondary - v*k_secondary)/(1-v^2) +((2*c2*k_primary)/(1-
v^2))*(B_req - (k_primary*Wi)/M(2) + (k_primary*k_secondary)/((1-v^2)*M(2)) -
(k_primary*k_secondary*v)/((1-v^2)*M(2))));
            %             p_nash = [P1 P2];


            sum = 0;
            sum_nash = 0;
            for j = 1:N
                if i ~= j
                    sum = sum + (k_secondary - p(j));
                    %                     sum = sum + (k_secondary -
p_nash(j));
                end
            end

            D1 = ((k_secondary*(v*(N-2)+1) - v * sum)/((1-v) * (v*(N-1)+1)));
            D2 = ((v*(N-2)+1))/((1-v) * (v*(N-1)+1));
            Demand(countx) = (((k_secondary - p(i))*(v*(N-2)+1) - v * sum)/
((1-v) * (v*(N-1)+1)));
            Demand2(countx) = D1-D2*p(i);


            R_primaryusers(countx) = c1*M(i);
            R_secondaryusers(countx) = p(i)*b(i);
            Costdiscount_primaryusers(countx) = c2* M(i) * ((B_req -
k_primary * ((Wi-b(i))/M(i)))^2);

            %Market Equilibrium Pricing model

            Market_profit(countx) = R_primaryusers(countx) +
R_secondaryusers(countx) - Costdiscount_primaryusers(countx);

            Supply(countx) = Wi - (M(i)/k_primary) * (B_req - (p(i))/
(2*c2*k_primary));

            %end market-equilibrium model

            %Competitive Pricing model

            Competitive_profit(countx) = p(i)*Demand(countx) + c1*M(i) -
c2*M(i)*((B_req - k_primary * ((Wi-Demand(countx))/M(i)))^2);
            Competitive_profit_derivative(countx) = 2*c2*k_primary*D2*(B_req
- k_primary * ((Wi - (D1 - D2*p(i)))/M(i))) +D1 - 2*D2*p(i);

            %             Demand_nash(countx) = (((k_secondary -
p_nash(i))*(v*(N-2)+1) - v * sum_nash)/((1-v) * (v*(N-1)+1)));
            %             Profit_nash(countx) = p_nash(i)*Demand_nash(i) +
c1*M(i) - c2*M(i)*((B_req - k_primary * ((Wi-Demand_nash(i))/M(i)))^2);

            %end Competitive pricing model
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            %save profit values for each price to a matrix
            market_profit_x = [market_profit_x Market_profit(countx)];
            competitive_profit_x = [competitive_profit_x
Competitive_profit(countx)];
            competitive_profit_derivative_x =
[competitive_profit_derivative_x Competitive_profit_derivative(countx)];
            primaryusers_profit_x = [primaryusers_profit_x
R_primaryusers(countx)];
            countx = countx + 1;
            p = [ ];

        end

        market_profit_y = [market_profit_y ; market_profit_x];
        competitive_profit_y = [competitive_profit_y ; competitive_profit_x];
        competitive_profit_derivative_y = [competitive_profit_derivative_y ;
competitive_profit_derivative_x];
        primaryusers_profit_y = [primaryusers_profit_y;
primaryusers_profit_x];


        %         hold on;
        %         plot(price1_x, competitive_profit_x, Col(county))
        %         grid on;
        %         xlabel('Price1')
        %         ylabel('Profit')
        %         title('Profit of primary service one as a function of
offered price');
        %         legend('p2=0', 'p2=1', 'p2=2', 'p2=3', 'p2=4', 'p2=5');
        %         hold off;

        county = county + 1;


    end

    total_market_profit_y = [total_market_profit_y; market_profit_y];
    total_competitive_profit_y = [total_competitive_profit_y;
competitive_profit_y];

    %hold on;
    mesh(price1_x,price2_x,competitive_profit_y)
    hold on;
    mesh(price1_x,price2_x,market_profit_y);
    hold on;
    mesh(price1_x,price2_x,primaryusers_profit_y);
    legend('Competitive Profit', 'Market-Equilibrium Profit', 'Without
sharing')
    title('Comparison of pricing models for primary service one');


end
[m,n] = size(market_profit_y);
%
% for i = 1:N
%     for k = 1: m
%         sum_marketprofit = total_market_profit_y(i*k,1:end) +
total_market_profit_y(2,1:end);
%         sum_competitiveprofit = total_competitive_profit_y(1,1:end) +
total_competitive_profit_y(2,1:end);
```

```
%
%
% mesh(price1_x,price2_x, sum_marketprofit)
% hold on;
% mesh(price1_x,price2_x, sum_competitiveprofit);
% hold on;
% mesh(price1_x,price2_x,  R_primaryusers);
% hold off;
```