Marginal Product Discrete Units of Workers

back to Fan's Intro Math for Econ, Matlab Examples, or Dynamic Asset Repositories

Marginal Product of Additional Workers (Discrete Workers)

Suppose we can not hire fractions of workers, but have to hire 1, 2, 3, etc.. What is the marginal product of each additional worker?

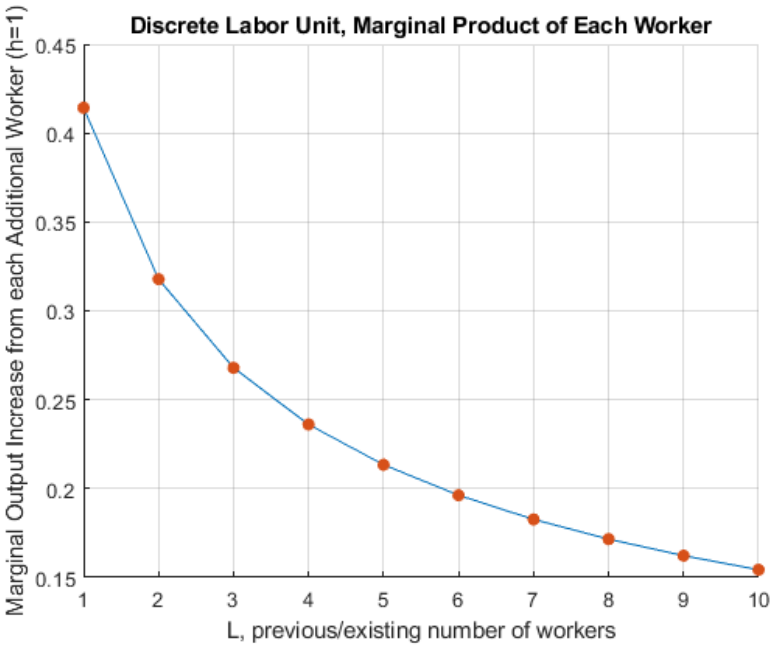
```
% fixed capital level
K = 1;
% current labor level
L = [1,2,3,4,5,6,7,8,9,10];

% Cobb Douglas Production Parameters
alpha = 0.5;
beta = 1-alpha;

% Output at x0
f_x0 = (K^alpha)*(L.^beta);

% a vector of h
h = 1;

% output at f_x0_plus_h
x0_plus_h = L+h;
f_x0_plus_h = (K^alpha)*((x0_plus_h).^beta);

% derivatie
output_increase = (f_x0_plus_h - f_x0)./h;

% Show Results in table
T = table(L', x0_plus_h', f_x0_plus_h', output_increase');
T.Properties.VariableNames = {'L', 'x0_plus_h', 'f_x0_plus_h', 'output_increase'};
T
```

T = 10×4 table

	L	x0_plus_h	f_x0_plus_h	output_increase
1	1	2	1.4142	0.4142
2	2	3	1.7321	0.3178
3	3	4	2.0000	0.2679
4	4	5	2.2361	0.2361
5	5	6	2.4495	0.2134
6	6	7	2.6458	0.1963
7	7	8	2.8284	0.1827
8	8	9	3.0000	0.1716
9	9	10	3.1623	0.1623

	L	x0_plus_h	f_x0_plus_h	output_increase
10	10	11	3.3166	0.1543

```
% Graph
close all;
figure();
hold on;
plot(L, output_increase);
scatter(L, output_increase,'filled');
grid on;
ylabel('Marginal Output Increase from each Additional Worker (h=1)')
xlabel('L, previous/existing number of workers')
title('Discrete Labor Unit, Marginal Product of Each Worker')
```



Using Derivative to approximate Increase in Output from More Workers

We know the MPL formula, so we can evaluate MPL at the vetor of L

```
% fixed capital level
K = 1;
% current labor level
L = [1,2,3,4,5,6,7,8,9,10];

% Cobb Douglas Production Parameters
alpha = 0.5;

% Output at x0
f_prime_x0 = (1-alpha)*(K^alpha)*(L.^(-alpha));

T = table(L', output_increase', f_prime_x0');
T.Properties.VariableNames = {'L', 'output_increase','f_prime_x0'};
```

```
T
```

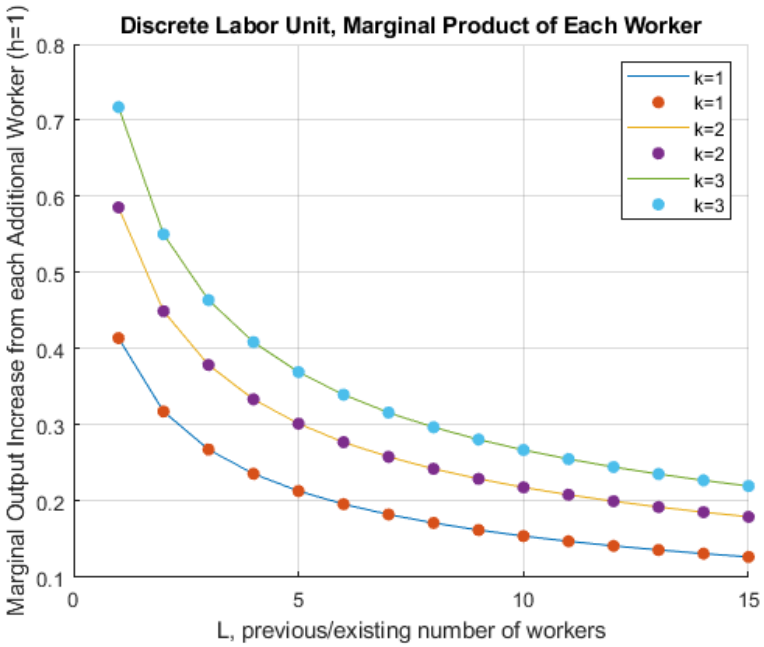
T = 10×3 table

	L	output_increase	f_prime_x0
1	1	0.4142	0.5000
2	2	0.3178	0.3536
3	3	0.2679	0.2887
4	4	0.2361	0.2500
5	5	0.2134	0.2236
6	6	0.1963	0.2041
7	7	0.1827	0.1890
8	8	0.1716	0.1768
9	9	0.1623	0.1667
10	10	0.1543	0.1581

Marginal Product of Additional Workers Different Capital (Discrete Workers)

Suppose we can not hire fractions of workers, but have to hire 1, 2, 3, etc.. What is the marginal product of each additional worker?

```
% fixed capital level
K1 = 1;
[f_prime_x0_K1, L] = MPKdiscrete(K1);
K2 = 2;
[f_prime_x0_K2, L] = MPKdiscrete(K2);
K3 = 3;
[f_prime_x0_K3, L] = MPKdiscrete(K3);

% Graph
close all;
figure();
hold on;
plot(L, f_prime_x0_K1);
scatter(L, f_prime_x0_K1,'filled');
plot(L, f_prime_x0_K2);
scatter(L, f_prime_x0_K2,'filled');
plot(L, f_prime_x0_K3);
scatter(L, f_prime_x0_K3,'filled');
grid on;
ylabel('Marginal Output Increase from each Additional Worker (h=1)')
xlabel('L, previous/existing number of workers')
title('Discrete Labor Unit, Marginal Product of Each Worker')
legend(['k=',num2str(K1)], ['k=',num2str(K1)],...
    ['k=',num2str(K2)],['k=',num2str(K2)],...
['k=',num2str(K3)],['k=',num2str(K3)]);
```




```
function [f_prime_x0, L] = MPKdiscrete(K)
% current labor level
L = [1,2,3,4,5,6,7,8,9,10,11,12,13,14,15];

% Cobb Douglas Production Parameters
alpha = 0.5;
beta = 1-alpha;

% Output at x0
f_x0 = (K^alpha)*(L.^beta);

% a vector of h
h = 1;

% output at f_x0_plus_h
x0_plus_h = L+h;
f_x0_plus_h = (K^alpha)*((x0_plus_h).^beta);

% derivatie
f_prime_x0 = (f_x0_plus_h - f_x0)./h;

end
```