MATLAB Case Study

Calculations when using an Energy-efficient(LED) Light-Bulb vs Standard(incandescent) Light-Bulb

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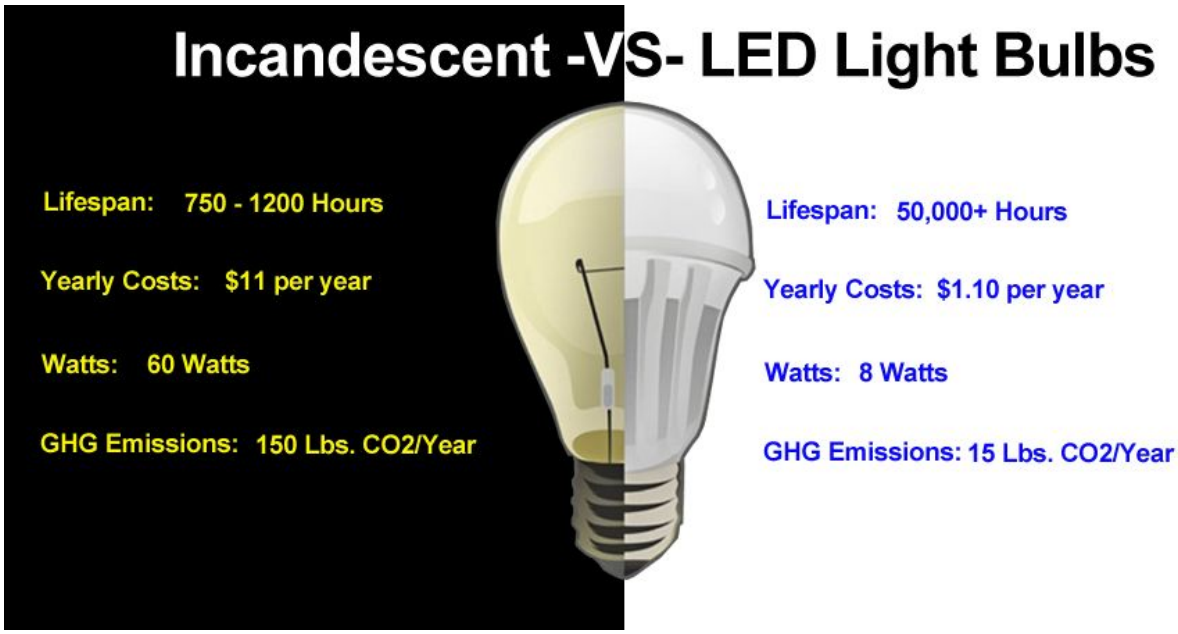
Introduction

LED(energy-efficient) is a highly energy efficient lighting technology, and it's changing the future of lighting in this world. LEDs use at least 75% less energy, and last 25 times longer, than incandescent lighting(standard light bulbs). Quality LED light bulbs last longer, are more durable, and offer comparable or better light quality than other types of lighting. LED light bulbs can last anywhere from 20,000 to 50,000 hours, or up to five times longer than any comparable bulb such as a standard light bulb. Even though LED light bulbs cost more money than an standard light bulb, LEDs last 3-25 times longer.



Code Overview

This program calculates the total cost of the user's bulb and compares the total costs versus that of an energy efficient bulb and standard bulb. The user inputs data for their lightbulb which includes the: watts, cost, and lifespan. If any of the user variables exceeded the highest possible value for that particular unit an error will be displayed and the user will be asked to input that value again. Kilowatts is calculated using the formula below. The variables for watts and time are defined for the energy-efficient bulb and standard bulb. The user will input the variables for watts and time for their bulb. The total cost is calculated using these variables and the user-inputed cost of energy in U.S. dollars.

$$kWh = \frac{Watts * Time(hrs)}{1000}$$

Energy-efficient light bulb	**Standard bulb**	**User's Variables**
Watts=25 (L1)	**Watts=100 (L2)**	**Watts=X (L3)**
Lifespan=10000 hours (L1time)	**Lifespan=750 hours (L2time)**	**Lifespan=X (L3time)**
Cost=4.40 (L1cost)	**Cost=.44 (L2cost)**	**Cost=X (L3cost)**

energycost= 'inputted by user' **measured in cost per kWH**

The total cost of the three bulb per the lifespan is calculated using the above variables which are defined in the code, and the variables from the user-inputted data.

kWh=(Watts x Lifespan)/1000

(kWh x energy cost)+ Cost of Bulb= Cost of bulb per it's Lifespan

To better compare the price of the three bulbs. The function was made to find the number of bulbs needed to meet the energy-efficient lifespan.

Energy-efficient lifespan/(****Standard lifespan or User****)= n**

That number was then multiplied by the cost of bulb per lifespan to get the total cost per 10,000 hours.

(Cost of bulb per it's Lifespan) x n=Total cost of bulb per 10,000 hours.

These values were compared on a graph. Additional calculations included the annual usage for a normal calendar year, the number of bulbs needs for all three bulbs to meet the user's annual usage, the total saving when switching over to energy-efficient bulbs

Annualusage=hours of use per day*365

Bulbs=Annualusage/Lifespan of bulb (*L1time, L2time, L3time*)

Totalsaving= (****Total Cost of Standard or User****) -Total Cost of Energy-efficient bulb**

*****Total saving is per 10,000 hours

******If "Total Saving" is negative that means the user's bulb is more efficient, and if they switch to the energy-efficient bulb they would lose money.

MATLAB Function:

```
clear,clc
%This program calculates the total cost the user's bulb and
compares to the
%total cost of an energy efficient bulb and standard bulb.
%The user inputs data for their lightbulb to include: watts,
cost, and lifespan.
%Cost is calculated using those variables and the user-inputed
cost of energy
%Written by Esmeralda Reyes & Emeka Onyeagba, 2018.

fprintf('This program calculates the cost the your bulb and
compares your total \n')
fprintf('cost to total cost of an energy efficient bulb and
standard bulb. \n')

energycost= input('Input energy cost per kilowatt hour in US
dollars with decimal:  '); %cost of energy in dollars per
kilowatt-hour

%Displaying energy cost per kWh
fprintf('$ %3.2f  \n', energycost)

%If not within range , error will come up
while energycost>.30
     disp('Error, the average energy cost range is 0.90.7')

     energycost= input('Input energy cost per kilowatt hour in
US dollar with decimal:  ');
end

L1 = 27.0; %energy-efficient light bulb watts usage
L2 = 100.0; %standard light bulb watts usage

%User inputs value for their light bulb
L3 =input('Input watts usage per individual bulb:  ');

%Displaying output of watts usage
```

```
fprintf('%3.2f watts \n', L3)

%Error comes if user exceeds amount of watts a household bulb
holds
while L3>150
     disp('Error, value inputted is too high for household
lighting, 150 is the max'')

     L3 =input('Input watts usage per individual bulb:  ');
end

L1time = 10000; %energy-efficient light bulb warranty in hours
L2time = 750;  %standard light bulb warranty in hours

%User inputs the light bulb lifespan in hours
L3time= input('Input lifespan of your light bulb in hours:  ');

%Error will occur if user inputs a number greater than a
lifespan of a bulb
while L3time>50000
     disp('Error, hours input is unachievable, 50000 is the
max'')

     L3time =input('Input lifespan of your light bulb in hours:
');
end

%Displaying lifespan of bulb
fprintf('%3.2f hours \n', L3time)

n=L1time/L2time;

L1cost= 4.40; %energy-efficient light bulb cost in dollars per
one bulb
L2cost= 0.44; %standard light bulb cost in dollars per one bulb

%User inputs amount of their bulb
L3cost=input('Input cost of individual light bulb in US dollars
with decimal:  ');
```

```
%If user exceeds limit of amount spent, error will be received
while L3cost>=50.00
     disp('Error, dollar amount too high for single household
light bulb , $50 is the max')

     L3cost=input('Input cost of individual light bulb in US
dollar with decimal:  ');

end

%Displaying individual light bulb cost
fprintf('$ %3.2f  \n', L3cost)

%Calculations
%Energy equals power multiplied by time
L1energyused= (L1*L1time)/1000; %energy-efficient energy usage
per bulb in kilowatts hours
L2energyused= (L2*L2time)/1000; %standard light bulb energy
usage per bulb in kilowatts hours
L3energyused= (L3*L3time)/1000; %standard light bulb energy
usage per bulb in kilowatts hours

%Displaying cost of each bulb per lifespan
L1total=L1energyused*energycost+L1cost;
fprintf('Total cost of energy-efficient bulb per its lifespan of
10,000 hours: $ %3.2f \n', L1total);

L2total=L2energyused*energycost+L2cost;
Con=L2total*n;  %n = number of standard bulbs to make the
lifespan of the energy-efficient bulb
fprintf('Total cost of standard bulb per 10,000 hours: $ %3.2f
\n', Con);

L3total=L3energyused*energycost+L3cost;
fprintf('Total cost of your bulb per its lifespan: $ %3.2f \n',
L3total);
n2=L1time/L3time; %number of the user's bulbs to make the
lifespan of the energy-efficient bulb
```

```
Yourbulb=n2*L3total;

%Displaying cost of bulb within 10,000 hour span
fprintf('Total cost of your bulb per 10,000 hours: $ %3.2f \n',
Yourbulb)

disp('-------------------------------------------------------------
-------------------------')
fprintf('Now using the program calculate the total number of
bulbs  \n')
fprintf('needed to meet your annual usage. \n')

%User input amount of hours light will be on per day
perday=input('How many hours per day will this light be in use?
');
%Error will be received if limit of hours are exceeded
while perday>24
     disp('Error, that exceeds the number of hours per day')
     perday=input('How many hours per day will this light be in
use?   ');

end

%Displaying amount of hours light will be on per day
fprintf('%3.0f hours  \n', perday)

%Calculating how many bulbs you'll go through in a year
annualusage=perday*365; %total hours the bulb will be in use
annually
fprintf('%3.0f hours per normal calendar year  \n', annualusage)

bulbs1=annualusage/L1time;
fprintf('You will need this number of energy-efficent bulbs to
meet your annual usage: %3.2f   \n', bulbs1)

bulbs2=annualusage/L2time;
fprintf('You will need this number of standard bulbs to meet
your annual usage: %3.0f   \n', bulbs2)
```

```
bulbs3=annualusage/L3time;
fprintf('You will need this number of bulbs to meet your annual
usage: %3.2f   \n', bulbs3)

%Defining the
graph-------------------------------------------------------------
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time=10000;
L1totalM=L1energyused*energycost;
L2totalM=L2energyused*energycost;

%Hourly cost of each bulb
Hourly1=L1totalM/time;
Hourly2=Con/time;
Hourly3=Yourbulb/time;

cost1=4.40:Hourly1 :L1total;
cost2=0.44:Hourly2 :Con;
cost3=L3cost:Hourly3 :Yourbulb;
cost1(1)=4.40;
cost2(1)=0.44;
cost3(1)=L3cost;

time1=1:10001;
time2=1:length(cost2);
time3=1:length(cost3);

%Plotting all three bulbs to compare
figure(1)
plot(time1, cost1, 'b-')
hold on
plot(time2, cost2, 'g-')
hold on
plot(time3, cost3, 'm-')

%Adding detailed labels for each plotted data series.
legend({'Energy-efficient','Your bulb','
Standard'},'FontSize',12,'TextColor','blue');
```
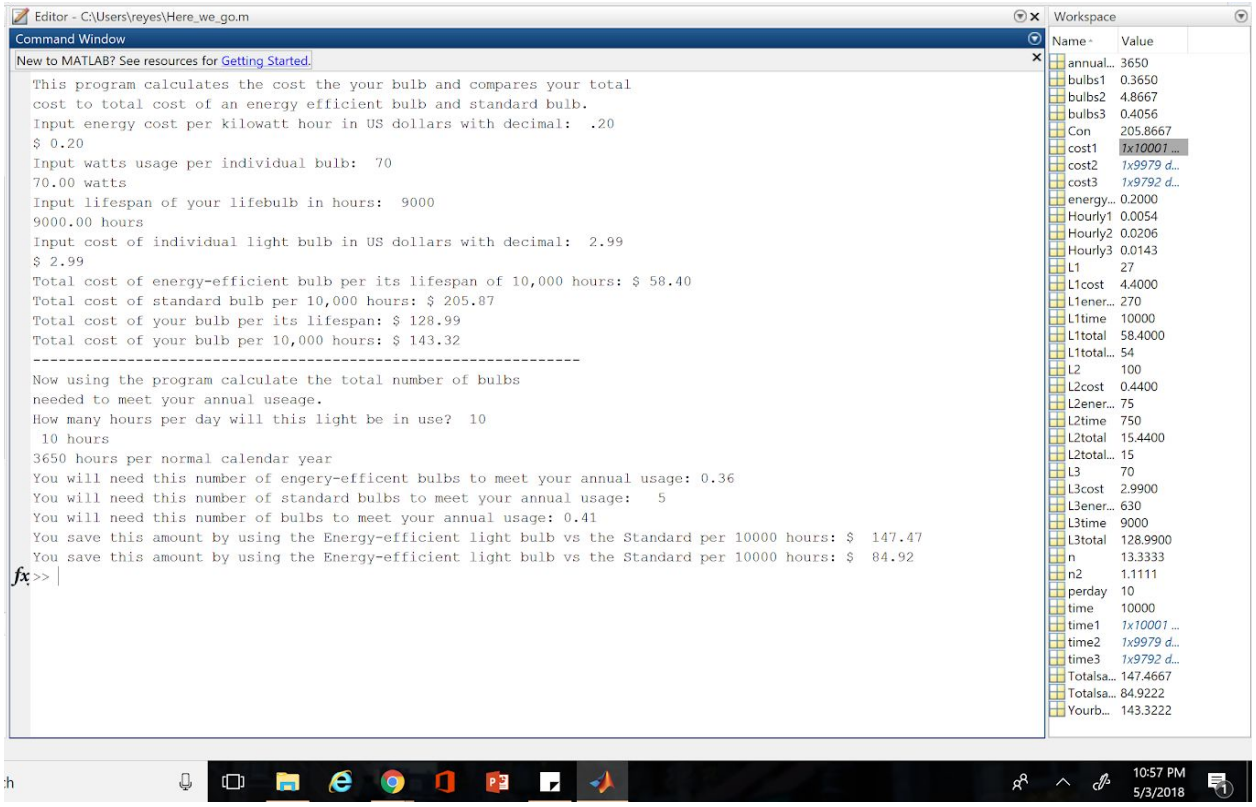
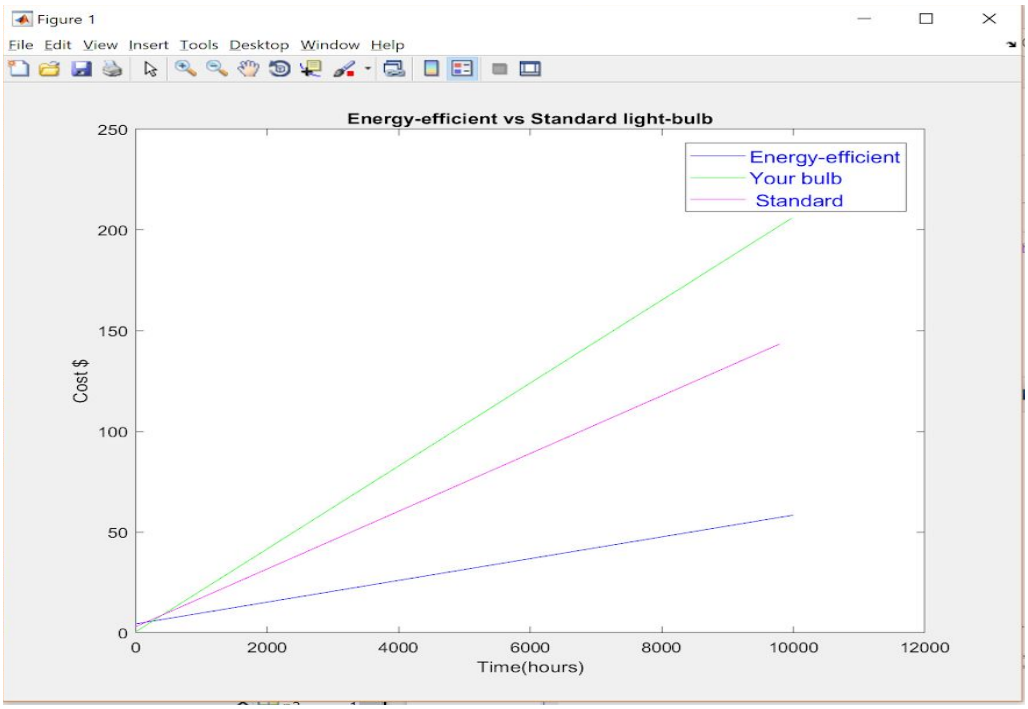
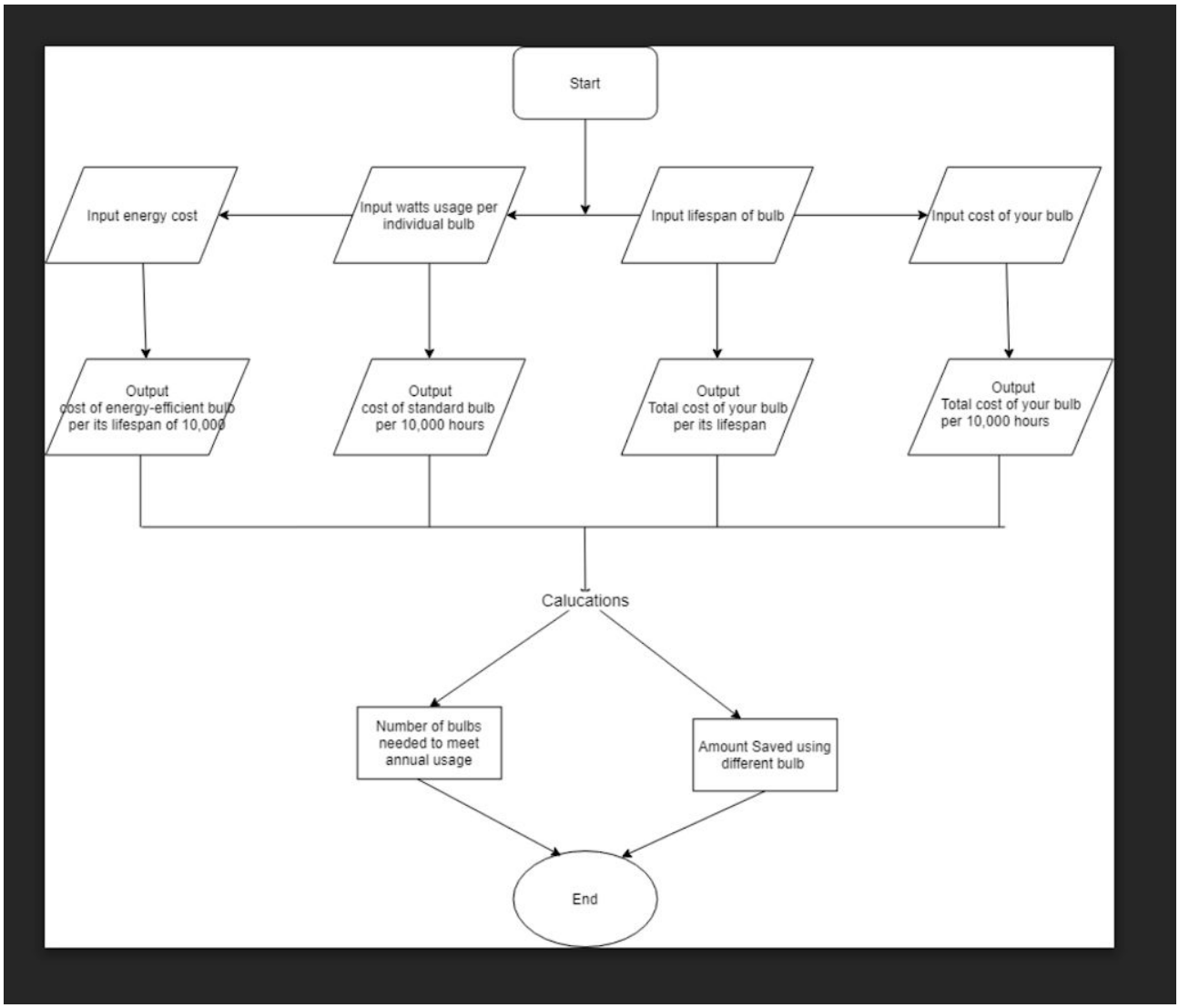

```
%Adding descriptions to graph
title('Energy-efficient vs Standard light-bulb')
xlabel('Time(hours)')
ylabel('Cost $')

%Giving the total Savings by using an Energy-efficient vs
Standard Light-bulb
Totalsaving = Con-L1total; %saving per 10,000 hours of usage
fprintf('You save this amount by using the Energy-efficient
light bulb vs the Standard per 10000 hours: $  %3.2f  \n',
Totalsaving)

TotalsavingUser = Yourbulb-L1total; %saving per 10,000 hours of
useage
fprintf('You save this amount by using the Energy-efficient
light bulb vs Your Bulb per 10000 hours: $  %3.2f  \n',
TotalsavingUser)
```

Trail Result

Here_we_go.m






Start
Input energy cost
Input watts usage per individual bulb
Input lifespan of bulb
Input cost of your bulb
Output cost of energy-efficient bulb per its lifespan of 10,000
Output cost of standard bulb per 10,000 hours
Output Total cost of your bulb per its lifespan
Output Total cost of your bulb per 10,000 hours
Calucations
Number of bulbs needed to meet annual usage
Amount Saved using different bulb
End