**Operations Research Project Report**

*On*

***Replacement of bulbs in SMV***

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**1. Abstract:-**This project describes the study of how the bulbs are replaced economically in a certain duration of time to save money. There are group replacement and individual replacement policies which is known after taking consideration of cost price, probability of failures, wages and discounted price. Since a large amount of bulbs are purchased the buyer will receive discounts which would in turn affect the replacement policies. Taking into account these factors the minimum group replacement cost is obtained.

**2. Introduction:-** Group replacement policy is considered as best replacement policy, but sometime there are chance of individual replacement also, if the discount is relatively negligible on the cost price of items. Two types of replacement policies are considered:-

**(i) Group replacement policy:-** In this all items are replaced, at the end of an optimal time period, irrespective of whether they have failed or not, with a provision that if any item fails before optimal time, it may be individually replaced.

**(ii) Individual replacement policy:-** In this an item is replaced immediately after it fails.

**3. Aim:-** To find the optimal replacement of bulbs in SMV, given the initial number of bulbs, wages, cost price of one bulb, discounted price of bulb.

**4. Problem description:-** The following failure rates have been observed for **4 fuse 36 watt CFL’s in hexagon(SMV)** in an installation with 3000 bulbs.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Month(X) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Cumulative  Probability of failure  P(X) | 0.09 | 0.13 | 0.26 | 0.33 | 0.45 | 0.52 | 0.65 | 0.72 | 0.88 | 0.92 | 1.0 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Month(X) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Probability of failure  P(X) | 0.09 | 0.04 | 0.13 | 0.07 | 0.12 | 0.07 | 0.13 | 0.07 | 0.16 | 0.04 | 0.08 |

The cost price of individual CFL is Rs 120, i.e. (replacement charge) with the maintenance charge of Rs 3000 per month for three employees. We assume that if all the CFL’s are replaced then we are given discount of 35% on the total price of replaced CFL’s.

(i) What is the best interval between group replacements?

(ii) Also establish if the policy as determined by you is superior to the policy of replacing CFL’s as and when they fail, there being nothing like “group replacement”.

(iii) At what group replacement per bulb would a policy of strictly individual replacement become preferable to the adopted policy?

**5. Formula Used:-**

(i).Calculation of probability distribution (p(x)) from cumulative distribution (P(X)):-

p(i)=P(i+1)-P(i)

where i=1,2,3…..n

where n is the number of months.

(ii). Calculation of expected number of failures:-

N(0)=N(0);

N(1)=N(0) x p(1);

N(2)=N(0) x p(2) + N(1) x p(1);

.

.

N(n)=N(0) x p(n) + N(1) x p(n-1) + ………up to N(n-1) x p(1)

(iii). Calculation of optimal group replacement interval:-

Average cost per month= (Total CFL’s x discounted price) + (Failure up to given month) x non-discounted price) divided by number of months.

(iv). Average (expected) number of failures per month:-

Average (expected) life of CFL’s = ∑i x p(i)

Average number of failure per week = Total number of CFL’s

Average number of failures per month

**6. Source code :-**

private void expectedFailures(Double pr[],int inputno,int totalbulbs,double individualprice, double discountedprice,int salary)

{

int i,h,k;

Double temp;

long []damagedbulbs= new long[25];

damagedbulbs[0]=totalbulbs;

for(i=1;i<=inputno\*2;i++)

{

temp=0.0;

h=0;

for(k=i;k>0;k--)

{

temp= temp+pr[k]\*(double)damagedbulbs[h];

temp=(double)(long)Math.round(temp);

h++;

}

//damagedbulbs[i]=Integer.parseInt(String.valueOf(temp));

damagedbulbs[i]=(long)Math.round(temp);

}

System.err.println("klsdfjaklsdklfkal");

for(i=1;i<=inputno\*2;i++)

TA.append("\nMonth"+(int)(i)+":"+damagedbulbs[i]);

double []cost= new double[25];

long bulb;

int index = 0;

double min=99000;

TA.append("\n\nCosts");

for(i=0;i<=inputno\*2;i++)

{

cost[i]=damagedbulbs[0]\*discountedprice;

bulb=0;

for(h=1;h<=i;h++)

bulb=bulb+damagedbulbs[h];

if(i!=0)

{

cost[i]=cost[i]+individualprice\*bulb+salary\*(i);

}

System.out.println(""+bulb);

if(i!=0)

{

cost[i]=cost[i]/i;

TA.append("\nMonth "+i+":"+cost[i]);

if(cost[i]<min)

{

min=cost[i];

index=i;

}

}

}

TA.append("\nAs Average minimum cost is in the "+index+" month is Rs"+cost[index]);

//Expected Life of light bulbs

double avgexpectedlife=0.0;

for(i=1;i<=inputno;i++)

avgexpectedlife=avgexpectedlife+i\*pr[i];

double avg=totalbulbs/avgexpectedlife;

TA.append("\n Average number of failures per month :"+avg);

double avgmonthlycost=avg\*individualprice+salary;

TA.append("\nCost of individual replacement of bulbs per month :Rs "+avgmonthlycost);

if(cost[index]<avgmonthlycost)

{

TA.append("\nCost of Group replacement of bulbs per "+index+" months is less than individual replacement policy. This Group replacement is preferred in this case.");

//more economical

double x;

x=((avgmonthlycost\*index)-discountedprice\*(damagedbulbs[index])-((index)\*salary))/totalbulbs;

TA.append("\nGroup replacement is preffered till the price per bulb does not exceed Rs"+x);

}

else

{

TA.append("\nCost of individual replacement of bulbs per month is more than group replacement policy. This Group replacement is not recommended for this set.");

}

}

private boolean validate(String s)

{

int i,count=0;

boolean flag=true;

for(i=0;i<s.length();i++)

{

if(((int)s.charAt(i)<48||(int)s.charAt(i)>57)&& s.charAt(i)!=46)

flag=false;

if(s.charAt(i)==46)

count++;

if(count>1)

flag=false;

}

return flag;

}

private void Process(java.awt.event.MouseEvent evt) {

if(!((n.getText().equals(""))&&(p0.getText().equals(""))&&(p1.getText().equals(""))&&(p2.getText().equals(""))&&(p3.getText().equals(""))&&(p4.getText().equals(""))&&(p5.getText().equals(""))&&(p6.getText().equals(""))&&(p7.getText().equals(""))&&(p8.getText().equals(""))&&(p9.getText().equals(""))&&(p10.getText().equals(""))))

{

if((validate(n.getText().toString()))&&(validate(p0.getText().toString()))&&(validate(p1.getText().toString()))&&(validate(p2.getText().toString()))&&(validate(p3.getText().toString()))&&(validate(p4.getText().toString()))&&(validate(p5.getText().toString()))&&(validate(p6.getText().toString()))&&(validate(p7.getText().toString()))&&(validate(p8.getText().toString()))&&(validate(p9.getText().toString()))&&(validate(p10.getText().toString())))

{

System.err.println("All Details Entered !! ");

if((Double.parseDouble(p0.getText().toString())+Double.parseDouble(p1.getText().toString())+Double.parseDouble(p2.getText().toString())+Double.parseDouble(p3.getText().toString())+Double.parseDouble(p4.getText().toString())+Double.parseDouble(p5.getText().toString())+Double.parseDouble(p6.getText().toString())+Double.parseDouble(p7.getText().toString())+Double.parseDouble(p8.getText().toString())+Double.parseDouble(p9.getText().toString())+Double.parseDouble(p10.getText().toString()))==1)

{

Event();

}

else

{

JFrame jf= new JFrame();

JOptionPane.showMessageDialog(jf,"Probablity not equal to 1");

}

}

else

{

JFrame jf= new JFrame();

JOptionPane.showMessageDialog(jf,"Please enter only Numeric Values");

}

}

else

{

//System.out.println("skladjflksdkl");

JFrame jf= new JFrame();

JOptionPane.showMessageDialog(jf,"Please fill all field and try again");

}

}

**7. Screenshots :-**





