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COMBINATION FORECASTING MODELING FOR CPFR

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Abstract

In this globalize economic development era, the market research is very much importance to survive in the competitive world. Market competition between individual enterprises has changed into competition between supply chains. Collaborative Planning, Forecasting and Replenishment (CPFR) which is an application of Supply Chain Management concepts in the retailing to coordinate the supply chain management activities between retailers and manufacturers. In this paper, a collaborative model is prepared based on conventional forecasting method with the help of c program and case study is carried out of daily need product requirement for next month utilizing previous month sales record.

INTRODUCTION

In this globalize economic development era, the market research is very much importance to survive in the competitive world. Market competition between individual enterprises has changed into competition between supply chains. The supply chain management (SCM), which includes management activities applied throughout the entire supply chain, abstracted more and more attention from industries and academics. Collaborative Planning, Forecasting and Replenishment (CPFR) which is an application of SCM concepts in the retailing to coordinate the supply chain management activities between retailers and manufacturers. CPFR concerns the collaboration where two or more parties in the supply chain jointly plan a number of promotional activities and work out synchronized forecasts, on the basis of which the production and replenishment processes are determined.

A CPFR model is prepared with help of c program by taking conventional method like least square method and exponential method to determine supply or demand for the next month. [5]

CPFR collaborative forecasting process:

CPFR is an application of SCM concepts in the retailing, which focuses on collaboration between retailers and suppliers to provide them a framework for sharing key supply chain information and coordination plans. Under CPFR, supply chain partners form a consensus forecast, either by working collaboratively or by first developing their own individual forecasts, which are then used to create a consensus forecast. This coordination and information sharing allows retailers and suppliers to optimize their supply chain activities. [1]

Whole CPFR procedure is divided into collaborated plan, forecasting and replenishment phases. The key of collaboration utilizing CPFR becomes the jointed demand forecast between retailers and manufacturers, which is then used to synchronize replenishment and production plans throughout the entire supply chain. The collaborative forecasting process is the cornerstone of the success of CPFR implementation. The collaborative forecasting process of CPFR gives a guarantee for precise demand by implementing the jointed forecasting

process inside the corporation and among the supplying chain of partners. The accuracy and collaboration are very important to evaluate a good CPFR forecasting process. The accuracy of collaborative forecasting can be determined by establishment of discrepancies standards and discrepancies handling. The forecasting discrepancies may be causes by inaccuracy of the data for forecasting or differences of the forecasting models used by different partners. The inaccuracy of the data for forecasting may be produced from inaccurate and un-timely sale data and the un-timely communication for changes caused by demands, such as alteration of advertisement plan, products promotion plan and alteration. The accuracy of data for forecasting can be improved through CPFR collaborative forecasting process among partners. The forecasting cycles of retailer may be several weeks or even one quarter due to numerous varieties of sale item. However, the manufacturers may forecast much accurate because their forecasting cycle might be one week due to fewer products varieties and more complex forecasting models. [4]

The simple average forecasting method is an easy way for forecasting in the CPFR collaborative forecasting process. However, the slightly more complex forecasting method can guarantee higher forecasting accuracy. In this paper, a combination-forecasting method which tries to combine the forecasting approaches used by retailers and manufacturers is modeled for more accurate and effective collaborative forecasting in CPFR process. There are three reasons why combination-forecasting method is applied for CPFR collaborative forecasting process between retailers and manufactures in the supply chain. The first reason is that combination-forecasting method can jointly utilize different forecasting models from different partners to smooth coordination in the supply chain and reduce forecasting discrepancies. The different interests of retailers and manufactures in the supply chain produce the discrepancies between their forecasting results. For example, retailers might concern more about sales loss caused by goods shortage, while manufacturers may concern more about overstock cost caused by surplus stock and

transportation cost caused by goods returning. It is impossible to accept only one party's forecast result, or just abandon one party's forecast model. A jointed forecasting model is needed to combine both parties' considerations. The second reason is that the combination-forecasting method can make use of resources from both retailers and manufacturers in the supply chain to obtain more accurate forecasting results and achieve coordination between partners in the supply chain. The retailers and manufacturers in the supply chain who have different knowledge and experience on forecasting utilize different method and data for forecasting. Combination with various forecasting resources can help to improve forecasting accuracy. The last reason is that combination-forecasting method can be used for not only functional product forecast but also seasonal product forecasting, which is suitable for various products forecasting in the supply chain. The functional product demand whose changes are located in the narrow limits can be considered as stationary or first-order stationary sequence in combination forecasting. The seasonal product demand trend can also be integrated to meet the requirement of combination forecasting. [5]

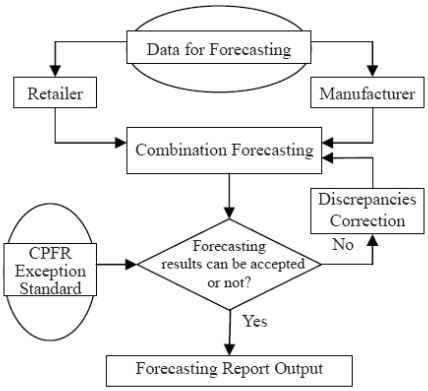

Fig 1. CPFR Collaborative forecasting flowchart

Nine step in CPFR process

The CPFR process model contains nine steps:

1) **Develop front-end agreement:** the parties involved establish the guidelines and rules for the collaborative relationship.
2) **Create joint business plan:** the parties involved create a business plan that takes into account their individual corporate strategies and defined category roles, objectives and tactics.
3) **Create sales forecast:** retailer point-of-sales data, causal information and information on planned events are used

by one party to create an initial sales forecast, this forecast is then communicated to the other party and used as a baseline for the creation of an order forecast.

4) **Identify exceptions for sales forecast**: items that fall outside the sales forecast constraints set in the front-end agreement are identified.
5) **Resolve / collaborate on exception items**: the parties negotiate and produce an adjusted forecast.
6) **Create order forecast:** point-of-sales data, causal information and inventory strategies are combined to generate a specific order forecast that supports the shared sales forecasts and joint business plan.
7) **Identify exceptions for order forecast:** items that fall outside the order forecast constraints set jointly by the parties involved are identified.
8) **Resolve / collaborate on exception items:** the parties negotiate (if necessary) to produce an adjusted order forecast.
9) **Order generation:** the order forecast is translated into a firm order by one of the parties involved. [5]

Conventional forecasting methods:

1) **Least square method (regression analysis)**

The least square method a very popular technique is used to compute estimations of parameters and to fit data. It is one of the oldest techniques of modern statistics as it was first published in 1805 by the French mathematician Legendre in a now classic memoir. But this method is even older because it turned out that, after the publication of Legendre's memoir, Gauss, the famous German mathematician, published another memoir (in 1809) in which he mentioned that he had previously discovered this method and used it as early as 1795. A somewhat bitter anteriority dispute followed (a bit reminiscent of the Leibniz-Newton controversy about the invention of Calculus), which, however, did not diminish the popularity of this technique. Galton used it (in 1886) in his work on the heritability of size which laid down the foundations of correlation and

(also gave the name) regression analysis. Nowadays, the least square method is widely used to find or estimate the numerical values of the parameters to fit a function to a set of data and to characterize the statistical properties of estimates

This is the mathematical method of obtaining the line of best fit between dependent variable and independent variable. This method is called least square method as the sum of square of the deviation of the various points from the line of best fit is minimum or least. It gives the equation of the line for which the sum of the square of vertical distances between the actual value and the line values are at minimum. In a simple regression analysis, the relationship between the dependent variable y and some independent variable x can be represented by a straight line.

$y = a + bx$ (1)

Where, a is y intercept,

b is slope of line

The values of the constant a & b are determined by the two simultaneous equation.

$\sum y = Na + b\sum x$ (2)

$\sum xy = a\sum x + b\sum x2$ (3)

These two equation are called normal equations to compute the values of a & b,

Calculate the deviation x for each period and also the sum of deviation.

- Find the value of $\sum x2$
- Find the value of $\sum xy$
- Calculate the value of a & b
- Make the sum of deviation $\sum x=0$

Substituting the value of $\sum x=0$ in above equation and calculate the value of a and b, after this obtain the line of best fit & predict the values of corresponding year/months.

Exponential Smoothing method

Exponential smoothing method requires only the current demand and the forecasted demand for the current month. Exponential smoothing is distinguished by the fact that it assigns weight to all previous data and the patterns of weights assigned are of exponential form. Demand for the most recent data is given more weight-age and the weights assigned to older period decrease exponentially. Thus exponential forecasting ensures that the forecast made by this method keeps pace with changing business trend. Simple exponential smoothing method estimate the average

forecast for the next period by using the actual and the forecasted demand for the previous period.

This method estimate the average forecast for next period by using actual and forecasted demand for the previous period. Forecast for period t [6]

$$F_t=F_{t-1}+\alpha [D_{t-1} - F_{t-1}] \quad (4)$$

Where,

F_{t-1}=forecasted demand for the last period.

D_{t-1}=Actual demand for the last period.

α = smoothing constant.($0.05< \alpha <0.1$)

Combination forecasting model of LSM & ESM by using C program

```
// forecasting model using least square method and Exponential smoothing method.
#include<stdio.h>
#include<conio.h>
int i=0;int j,count=0,estiyear,assign;
char ch;
struct sales
{int year; float sales;    b     };
struct sales x[50];
void initialise()
{     do     {                printf("\nenter the year\n");
            scanf("%d",&x[i].year);
             printf("enter the coursponding sale\n");
             scanf("%f",&x[i].sales);
       i++;
   count=i;
     printf("do you want to enter one more record(y/n)?");
       ch=getch();       }
while(ch!='n');
printf("\ndisplay of our historical data:\n");
printf("-------------------------------------------------\n");
 printf("|       Year   |     Sales  |\n");
printf("-------------------------------------------------\n");
   for(j=0;j<i;j++)
   { // printf("\n|");
         printf("|%12.2d                    |%12.2f|\n",x[j].year,x[j].sales);
      //printf("|");        }
printf("-------------------------------------------------\n");   }
void exposmoothing()
{       float alpha;
         printf("\nenter the value of alpha\n");
        scanf("%f",&alpha);
        float fordemand[count];
        printf("enter the forecast demand of %d year",x[0].year);
        scanf("%f",&fordemand[1]);
       // printf("%f",fordemand[1]);
    printf("\nFORECAST DEMAND CALCULATION\n");
   printf("-------------------------------------------------\n");
   printf("|       Year    | Forecast Demand |\n");
   printf("-------------------------------------------------\n");
   for(i=1,j=0;i<=count && j<=count-1;)
   {     float oldfordemand=fordemand[i];
         i++;
         fordemand[i]=alpha*x[j].sales+(1-alpha)*oldfordemand;
         j++;
         if(j==count)
```

```
        {     //assign=++x[--j].year;
        printf("|%12.2d |%14.2f    |\n",++x[--
j].year,fordemand[i]);          }       else
   { printf("|%12.2d |%14.2f
|\n",x[j].year,fordemand[i]);         }
  } printf("----------------------------------------
------------------\n"); printf("Forecast sale for
year %d
is=%f",assign,fordemand[++count]);   }
void leastsquare()
{                                          //float
year[50],sale[50],deviation[50],squredev[50
],xy[50];
float
sumy=0,sumsqdev=0,sumxy=0,sumx=0;
float a,b,Estimate;
float predict;
float
deviation[count],squredev[count],xy[count]
,y[count];
    /*for(i=0,j=1;j<=count;i++,j++);
 {       y[j]=x[i].sales;
              printf("\n%f",y[1]);       }*/
            if(count%2!=0)
    {     i=ceil((float)count/2);
          int k=0,r=0,m=i;
            while(m<=count)   {
              deviation[m++]=k++;
            }        while(i>=1)
            {          deviation[--i]=--r;          }
}
            else
            {        i=ceil((float)(count+1)/2);
              //printf("%d",i);
              int j=i;
              deviation[i]=0.5;
              float sum1=deviation[j];
              float sum=deviation[i];
              while(i<=count)
              {
deviation[++i]=++sum;
                sum=deviation[i];        }
                while(j>=1)
                {          deviation[--j]=--sum1;
                  sum1=deviation[j];             }
}
                  printf("----------------------------
-------------\n");
 printf("|      Year   |   sales(y) |    dev.(x) |
sq. dev.  |     xy   |\n");
  printf("----------------------------------------------
---\n");
  // printf("\n| year  | sales(y) | dev.(x) | sq.
dev. |  xy   |\n");
//printf("----------------------------------------------
---------------\n");
                for(i=1,j=0;i<=count;i++,j++)
                {

squredev[i]=deviation[i]*deviation[i];

xy[i]=x[j].sales*deviation[i];

printf("|%12.2d|%12.2f|%12.2f|%12.2f|%1
2.2f|\n",x[j].year,x[j].sales,deviation[i],squr
edev[i],xy[i]);
                }
                printf("----------------------------
----");

            //printf("\nDeviation      of      all
records\n");
            /*for(i=1;i<=count;i++)
            {
             printf("\n%f",deviation[i]);
             }*/
            //printf("\nSquare                 of
Deviation\n");
            /*for(i=1,j=0;i<=count;i++,j++)
            {
            //xy[i]=x[j].sales*deviation[i];

squredev[i]=deviation[i]*deviation[i];
```

```
            printf("\n%f ",squredev[i]);
}*/
            /*printf("\nmultiplication of
deviation and sale");
            for(i=1,j=0;i<=count;i++,j++)
    {         xy[i]=x[j].sales*deviation[i];
            printf("\n%f",xy[i]);       }*/
            for(i=1,j=0;i<=count;i++,j++)
        {       sumy=sumy+x[j].sales;
                sumx=sumx+deviation[i];

sumsqdev=sumsqdev+squredev[i];
                sumxy=sumxy+xy[i];      }
            //printf("\n----------------------------
-----------------");
printf("\n|N=%7.2d|sumy=%7.2f|sumx=%7.
2f|sumx2=%7.2f|sumxy=%7.2f|",count,sum
y,sumx,sumsqdev,sumxy);
            printf("\n----------------------------
---------------");
            a=(float)sumy/count;
            b=(float)sumxy/sumsqdev;
            do
            {
         printf("\nEnter the year which sale
is to be forecast\n");
            scanf("%d",&estiyear);
            //printf("\n%d",x[--count].year);
 predict=((estiyear-x[--
count].year)+1)+deviation[count];
            /*printf("\n%f",a);
            printf("\n%f",b);
            printf("\n%d",predict);*/
            Estimate=a+b*predict;
 printf("\n the sale for %d year
is=%f",estiyear,Estimate);
 printf("\ndo you want to predict another
year sales(y/n)?");
            ch=getch();
            }while(ch!='n'); }
        int main()
        {  int choice;
            char ch;
             printf("\n enter the previous data
to process\n");
            initialise();
            printf("\n----------------------------
----------------");
            printf("\n METHODS TO
FORECAST DATA");
            printf("\n1.Least Square
method\n");
            printf("2.Exponential Smoothing
Method\n");
printf("choose the Favourite Forecasting
Method(1 or 2):\n");
scanf("%d",& choice);
 switch(choice)
            {
                case 1 : printf("\n----------
----------");
                        printf("\nUsing Least
Square Method\n");
                        printf("----------
----------");
                        leastsquare();
                        break;
 case 2 :
printf("\n_____
_____"); printf("\n Using
Exponential Smoothing Method\n");
printf("_____
_____"); exposmoothing();
 break;
 default :printf("select correct option\n");
break;      }
   getch();
  return 0;
}[9]
```

CASE STUDY OF MEDICAL STORE:

The following data gives the sales of the daily need product of retailer for various months. Forecast the sales for next month by conventional methods using c program.

Month/Year(2000)	Sales(Thousand)
Jan	13
Feb	20
Mar	20
Apr	28
May	30
Jun	32
July	33
Aug	38
Sep	43

The forecast for next month of Oct. Nov. Dec. will be predicted by using this model based on conventional method

Predicted sale for the next month Oct, Nov, Dec -2000 By using LSM & ESM with the help of Model. As follows.

Month/Year(2000)	Predicted Sales(Thousand) by using LSM	Predicted Sales(Thousand) by using ESM	Actual sale for the Month
Oct-2000	46	40	44
Nov-2000	49	42	47
Dec-2000	53	43	51

Conclusion:

The result obtained using conventional method is compared with the actual sales of daily need product of retailer and found to be approximately equal. Out of these two methods least square and exponential smoothing method, the result obtained least square method is better than other. Thus least square method is good conventional method for forecasting.

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