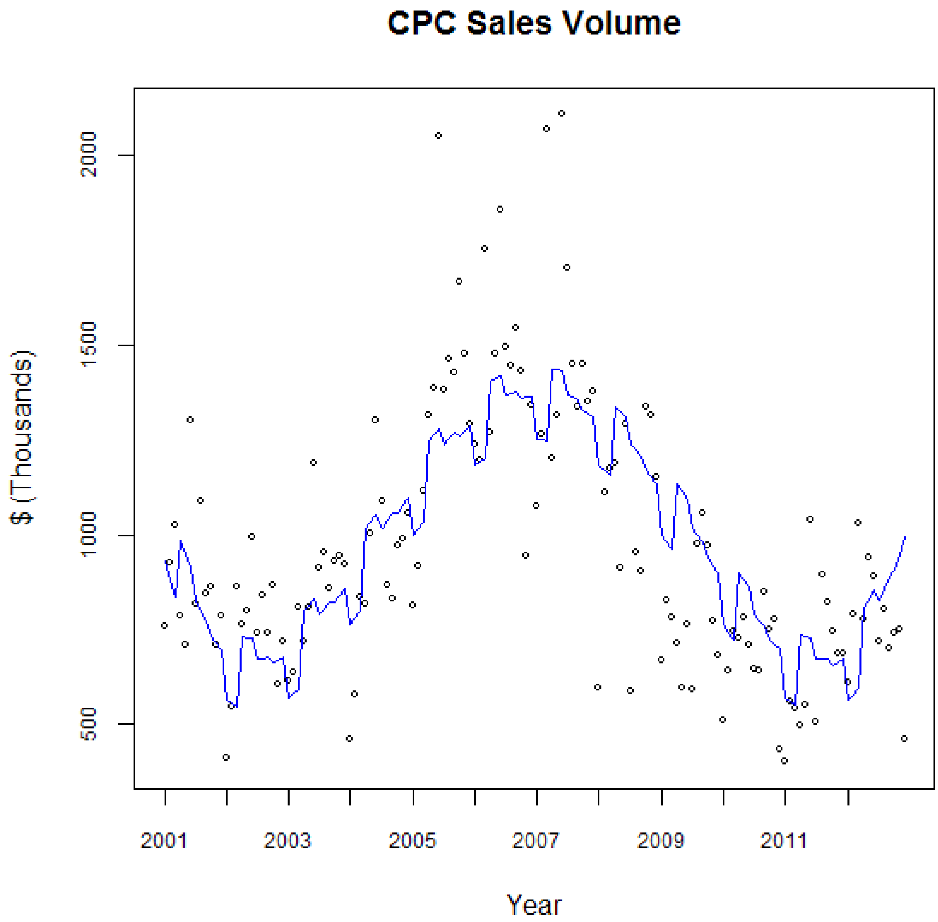
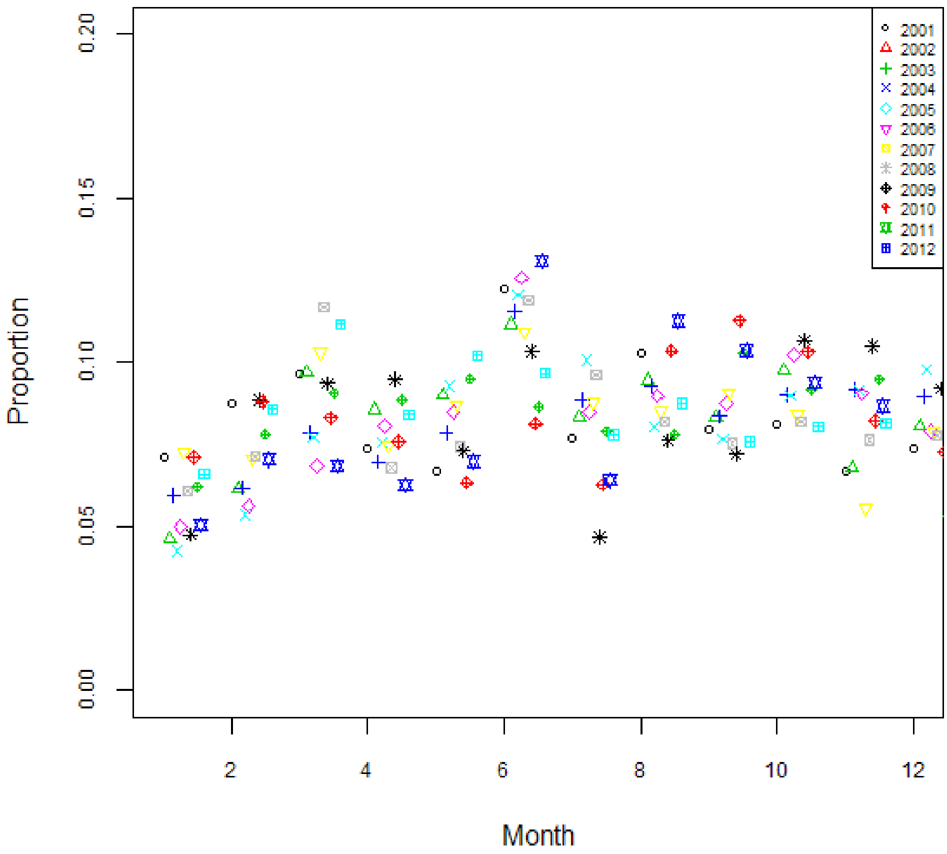
***Cyclic Sales Analysis***

A question arose as to the cyclic nature of sales at Carolina Precast Concrete. Not surprisingly, monthly sales are somewhat cyclic (periodic sub-behavior of function in first plot), but interestingly, over a twelve year period, the monthly sales plot has a near symmetric form (primary shape of function in first plot). A fourth order polynomial was fit to the data, not as an explanatory model, but simply to add a smooth function to highlight trends. All programming was accomplished in R.




The following plot shows sales contribution (annual proportion) by month. Years are symbol and color coded for isolation.

## CPC Monthly Sales Proportion



## Program Listing

```
# Carolina Precast Concrete Seasonal Sales Model

# Collect historical sales data

library(RODBC)
db=odbcConnect('CPCData',uid='sa',pw='')
sales <- sqlQuery(db,
         paste("select   Year as SalesYear, Month as SalesMonth, sum(BilledThisMonth) as
BilledVal ",
               "from     CPCBillingHist ",
               "where    Year between 2001 and 2012 ",
               "group by Year, Month"))
odbcClose(db)

# Setup predictor variables - 4th deg polynomial for year/month, linear adder for season
# Center time values to set correlation between x, x*x, x**3, and x**4 to 0
# x div by 100 reduces scale of higher products (x^2, x^3, x^4)
# Note that x and x^3 have been omitted as a result of non-significance in regression analysis
x1 <- (0:(nrow(sales)-1)-nrow(sales)/2)/100
X <- cbind(rep(1, nrow(sales)), "x2"=x1*x1, "x4"=x1^4, "s1"=0, "s2"=0, "s3"=0)

# Set season indicator variables: 000 for jan-mar, 100 for apr-jun, 010 for jul-sep, and 001 for
oct-dec
X[which(sales$SalesMonth>3 & sales$SalesMonth<7), "s1"] <- 1
X[which(sales$SalesMonth>6 & sales$SalesMonth<10), "s2"] <- 1
X[which(sales$SalesMonth>9 & sales$SalesMonth<13), "s3"] <- 1

# Calculate model coefficents
beta <- as.vector(solve(t(X)%*%X)%*%t(X)%*%sales$BilledVal)
names(beta) <- c("b0", "b2", "b4", "s1", "s2", "s3")

# Calculate estimated sales values
Y <- beta["b0"] + beta["b2"]*x1*x1 + beta["b4"]*x1^4 + beta["s1"]*X[,"s1"] +
     beta["s2"]*X[,"s2"] + beta["s3"]*X[,"s3"]

# Plot supplied data and 4th order regression polynomial
plot(sales$BilledVal~x1, main="CPC Sales Volume", xlab="Year", ylab="$ (Thousands)", cex=.5,
cex.axis=.75, xaxt="n")
lines(Y~x1, col="blue")
axis(1, labels=sales$SalesYear[seq(1, nrow(sales), 12)], at=x1[seq(1, nrow(sales), 12)],
cex.axis= .75)

# Accumulate annual sales for proportion calculation
year <- min(sales$SalesYear):max(sales$SalesYear)
ySales <- cbind(rep(0, NROW(year)))
rownames(ySales) <- year
for(i in 1:NROW(year)) ySales[i] <- sum(sales$BilledVal[which(sales$SalesYear==year[i])])
# Now, plot annual sales proportions by month
plot(sales$BilledVal[which(sales$SalesYear==year[1])]/ySales[1]~sales$SalesMonth[which(sales$Sale
sYear==year[1])],
     main="CPC Monthly Sales Proportion", ylim=c(0,.15), xlab="Month", ylab="Proportion",
     pch=1, cex=.75, cex.axis=.75)
cpal <- palette()
# Note the slight shift in the x-dimension to prevent symbol overlay
for(i in 2:NROW(year))
  points(sales$SalesMonth[which(sales$SalesYear==year[i])]+i*.05,
sales$BilledVal[which(sales$SalesYear==year[i])]/ySales[i],
         pch=i, col=i%%NROW(cpal)+1, cex=.75)
legend("topright", legend=year, pch=c(1:NROW(year)), cex=.6, col=cpal)
```