

3.3 Time Series Plot

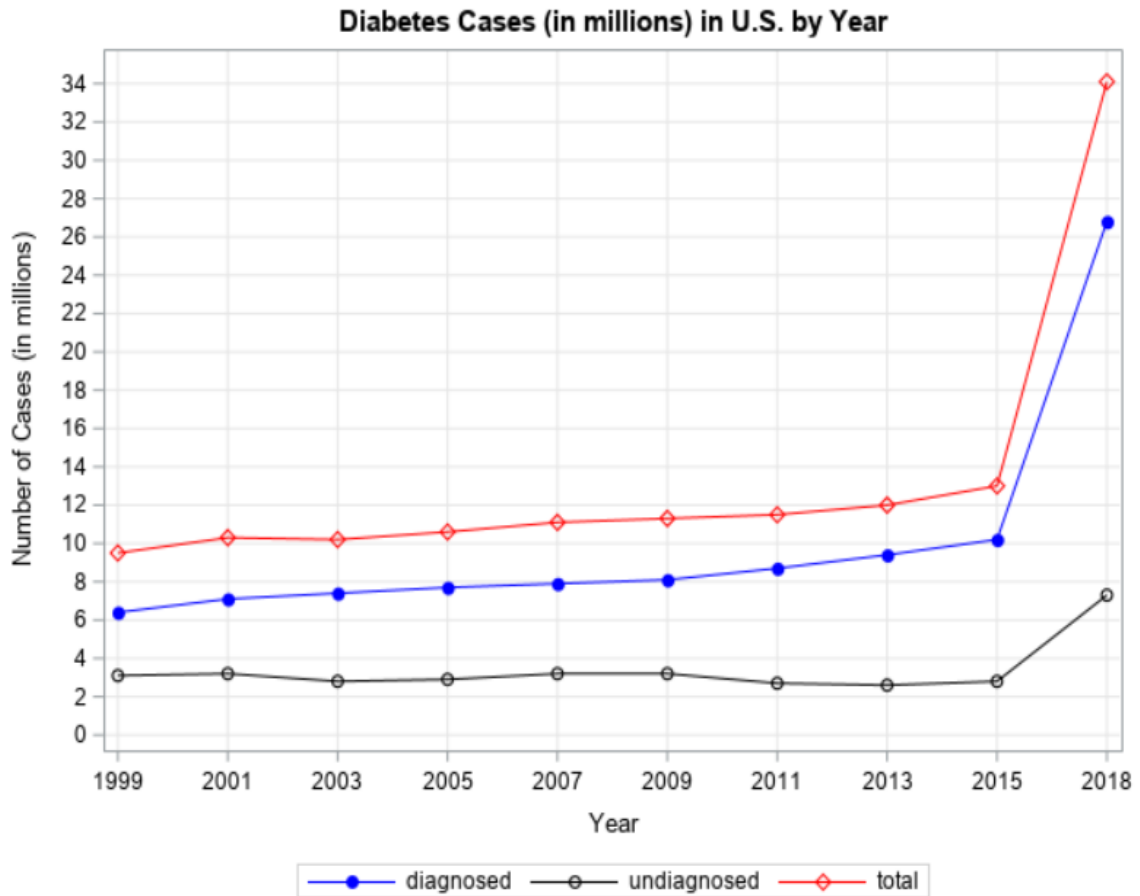
Continuous observations collected longitudinally may be plotted against time producing a **time series plot**. Such plots are described in terms of overall trends: increases, decreases, periodicity, and seasonality.

Example. The data set for this example contains the number of diagnosed, undiagnosed, and total cases of diabetes (in millions) in U.S. between 1999 and 2018. The codes below produce the time-series plots in SAS and R.

In SAS:

```
proc import out=diabetes3 datafile="./diabetes_data3.csv" dbms=csv replace;

title 'Diabetes Cases (in millions) in U.S. by Year';
proc sgplot data=diabetes3;
series x=year y=diagnosed/ legendlabel='diagnosed' markers
markerattrs=(color=blue symbol=circlefilled) lineattrs=(color=blue
pattern=solid);
series x=year y=undiagnosed/ legendlabel='undiagnosed' markers
markerattrs=(color=black symbol=circle) lineattrs=(color=black
pattern=solid);
series x=year y=total/ legendlabel='total' markers
markerattrs=(color=red symbol=diamond) lineattrs=(color=red pattern=solid);
xaxis label='Year' type=discrete grid;
yaxis label='Number of Cases (in millions)' grid values=(0 to 35 by 1);
run;
```



In R:

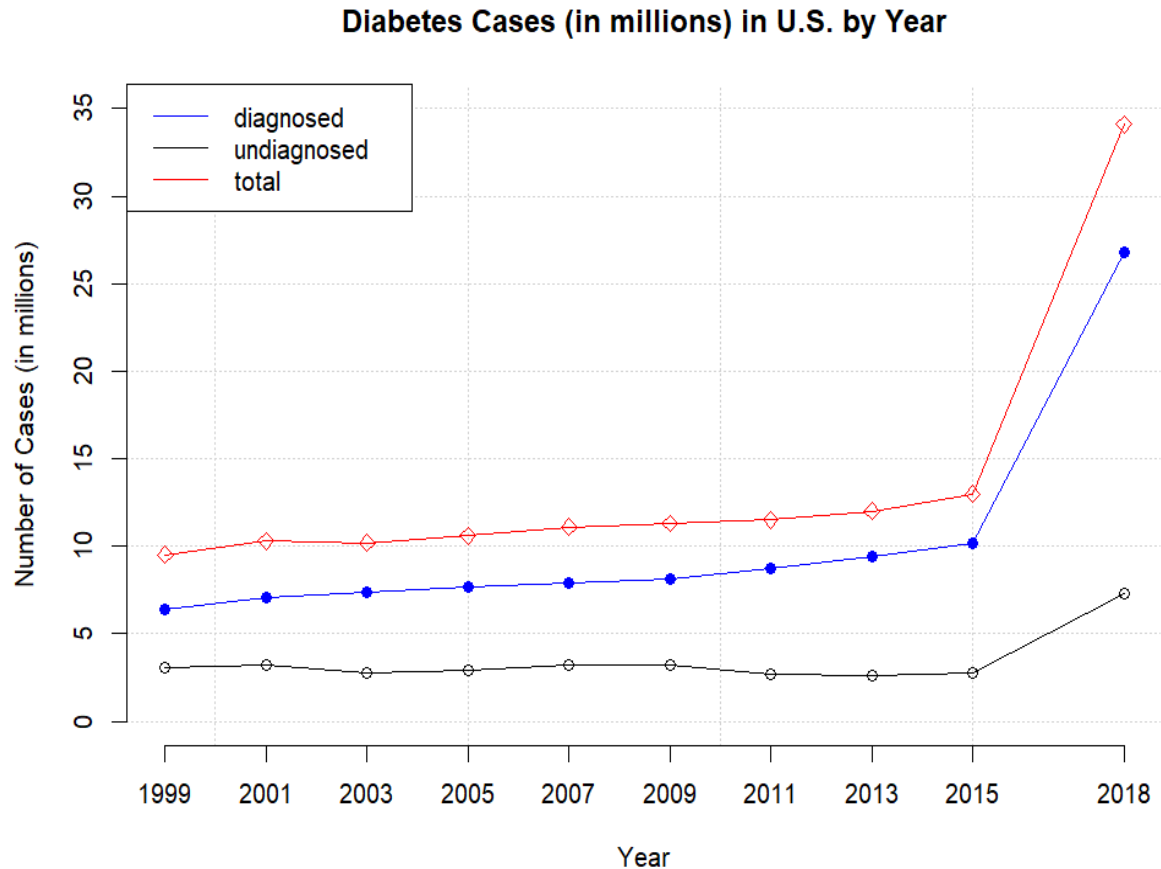
```
diabetes3.data<- read.csv(file="./diabetes_data3.csv", header=TRUE, sep=",")

plot(diabetes3.data$year, diabetes3.data$diagnosed, type="l", col="blue",
main="Diabetes Cases (in millions) in U.S. by Year", xlim=c(1999,2018),
ylim=c(0,35), xlab="Year", ylab="Number of Cases (in millions)", axes=FALSE,
panel.first=grid())
axis(side=1, at=c(seq(1999,2015,by=2), 2018))
axis(side=2)
lines(diabetes3.data$year, diabetes3.data$undiagnosed, col="black")
lines(diabetes3.data$year, diabetes3.data$total, col="red")
points(diabetes3.data$year, diabetes3.data$diagnosed, pch=16, col="blue")
#pch=plot character 16=dot
points(diabetes3.data$year, diabetes3.data$undiagnosed, pch=1, col="black")
#1=circle
```

```

points(diabetes3.data$year, diabetes3.data$total, pch=5, col="red")
#5=diamond
legend("topleft", c("diagnosed", "undiagnosed", "total"), lty=1, col=c("blue",
"black", "red"))

```



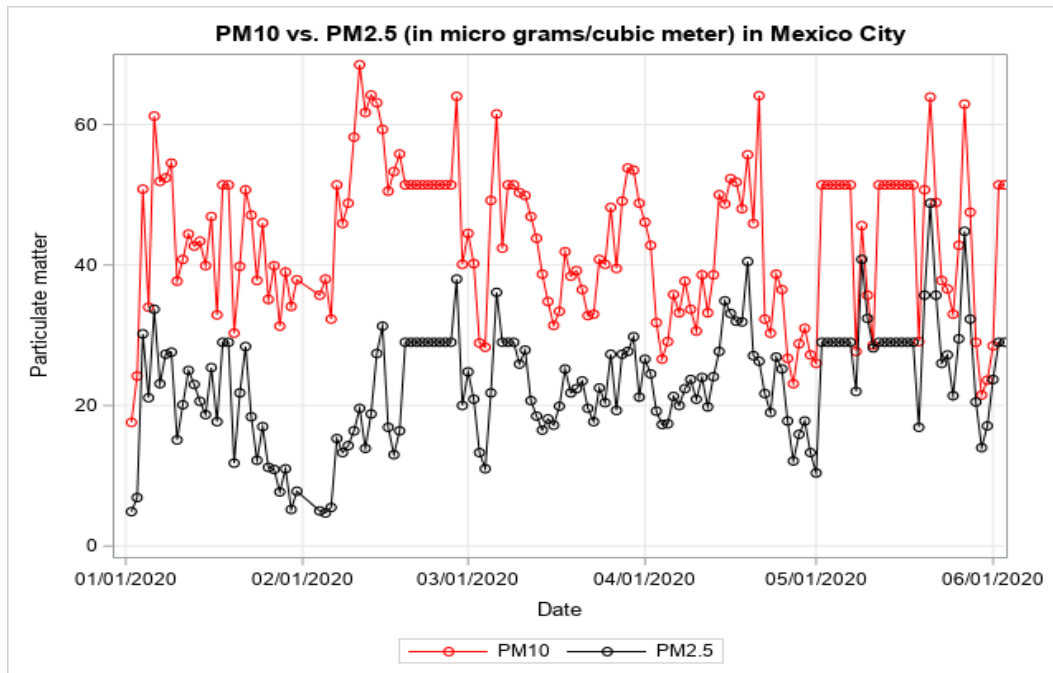
Example. In this example we plot particulate matter PM10 vs. PM2.5 (in micro grams per cubic meter) that were recorded in Mexico City between January 2,2020, and June 3, 2020.

A note: **PM2.5** refers to atmospheric particulate matter (PM) that has a diameter of fewer than 2.5 micrometers. **PM10** refers to atmospheric particulate matter that has a diameter of fewer than 10 micrometers. The difference between the two particulate matters lies in where they reside in the human body. PM2.5 is likelier to travel into and deposit on the surface of the deeper parts of the lung, while PM10 is likelier to deposit on the surfaces of the larger airways of the upper region of the lung.

In SAS:

```
proc import out=pollution datafile="/pollution.csv" dbms=csv replace;

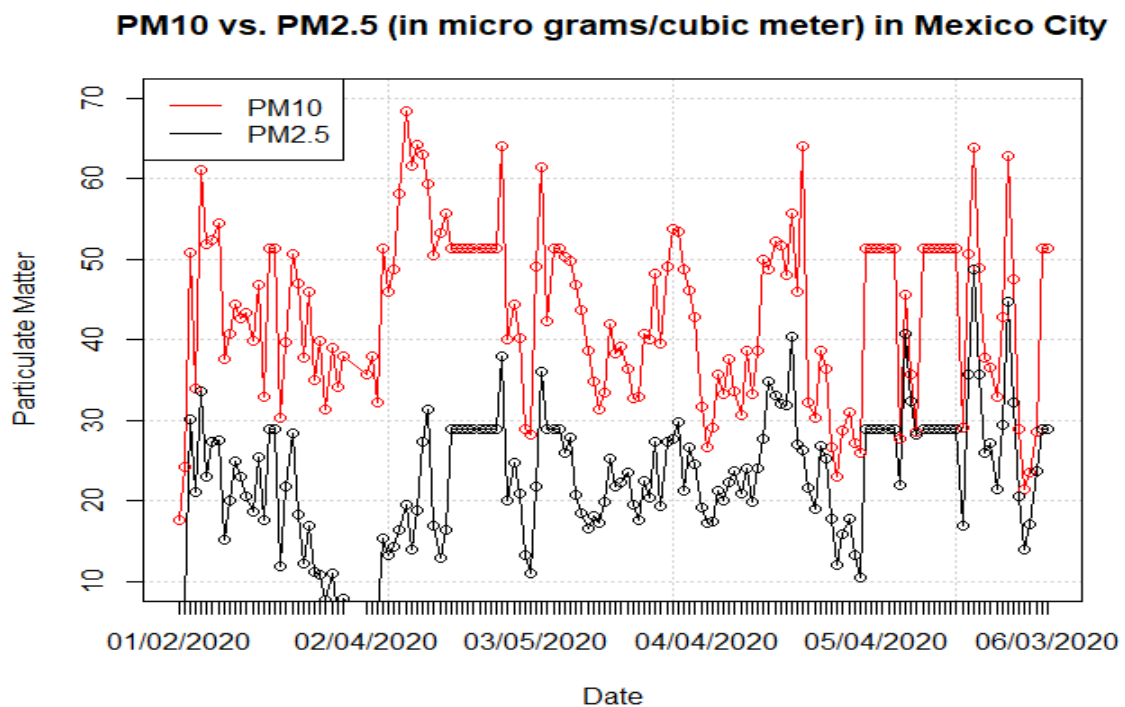
title 'PM10 vs. PM2.5 (in micro grams/cubic meter) in Mexico City ';
proc sgplot data=pollution;
series x=date y=PM10/ legendlabel='PM10' markers
markerattrs=(color=red symbol=circle) lineattrs=(color=red pattern=solid);
series x=date y=PM2_5/ legendlabel='PM2.5' markers
markerattrs=(color=black symbol=circle) lineattrs=(color=black
pattern=solid);
axis label='Date' values=('1jan20'd to '1jun20'd by month) grid;
axis label='Particulate matter' grid;
run;
```



In R:

```
pollution.data<- read.csv(file="/pollution.csv", header=TRUE, sep=",")

plot(as.Date(pollution.data$Date, "%m/%d/%Y"), pollution.data$PM10,
type="l", col="red", main="PM10 vs. PM2.5 (in micro grams/cubic meter)
in Mexico City", ylim=c(10,70), xlab="Date", ylab="Particulate Matter",
xaxt="n", panel.first=grid())
lines(as.Date(pollution.data$Date, "%m/%d/%Y"), pollution.data$PM2.5,
col="black")
points(as.Date(pollution.data$Date, "%m/%d/%Y"), pollution.data$PM10,
pch=1, col="red")
points(as.Date(pollution.data$Date, "%m/%d/%Y"), pollution.data$PM2.5,
pch=1, col="black")
legend("topleft", c("PM10", "PM2.5"), lty=1, col=c("red", "black")) axis(1,
at=as.Date(pollution.data$Date, "%m/%d/%Y"),
labels=format(as.Date(pollution.data$Date, "%m/%d/%Y"), "%m/%d/%Y"))
```



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