Question 1: What is the trend line equation using the 1994 data? Examine the Session window and locate the trend line equation for the time series 1088-1994. Copy and paste into your report and evaluate the equation. What is the average increase or decrease in sales over the long run? Note: The x placed into the equation will the future time period for which you wish to forecast.

Question 2: Using Minitab Stat Guide and the text Page 183 evaluate the component, and the time series graphs. These graphs will be part of the Minitab display. See Pages 182 of your text for example of component graph and Page 183 for Seasonal Analysis graph. See Page 186 for Multiplicative Decomp graph example. Present the graphs in with your analysis of graphs.

Look at the Multiplicative Decomposition Graph (P186) how well does the fitted data match the actual data? Provide graph with evaluation below graph.

Evaluate the Component Analysis Graph for Sales (Pg182) Shows Minitab output you will need. Provide the graph set and evaluate each of the four boxes in the graph: Be sure to include the equations for each of the following. Provide a brief discussion of each panel.

> Equations:
> Seasonally Adjusted panel (Page 179) Is Seasonality a factor in the time series?
> Detrended Panel (Page 181)
> Seasonally Adjusted and Detrended (Page 183)
> What do the seasonal indexes tell you about seasonal fluctuations?

Question 3: As previous instructed, to make comparisons of sales and forecasts easier to evaluate, copy the forecasts out of the main worksheet FORE1 Column and paste into the worksheet containing the data for 1995. Pasting the values next to one another will allow for clearer visualization of the data. Once you have pasted the values into the 1995 worksheet move the columns to the Session window using Data>Display Data. Copy the data for Sales and Forecasts and place into a table in your report. Evaluate the overall accuracy of what you see. This is to be a summary do not provide a line-by-line description. Include the MPE and MAPE values in your evaluation.

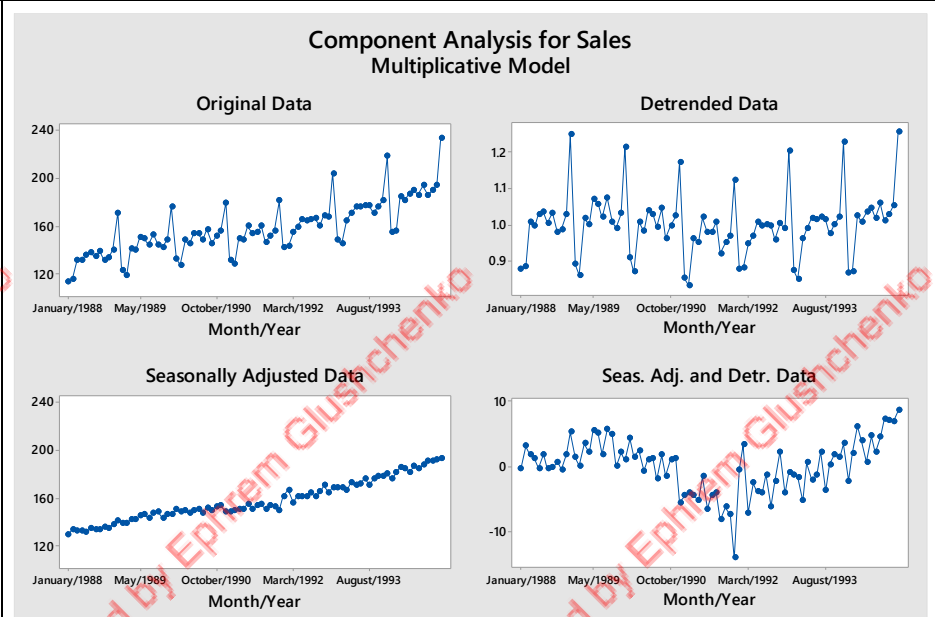| Row	Month	Sales	Row	Month	Sales	Row	Month	Sales	Row	Month	Sales
1	January/1988	113.6	49	January/1992	142.1	26	February/1990	127.3	74	February/1994	155.8
2	February/1988	115.0	50	February/1992	143.1	27	March/1990	148.3	75	March/1994	184.2
3	March/1988	131.6	51	March/1992	154.7	28	April/1990	145.0	76	April/1994	181.8
4	April/1988	130.9	52	April/1992	159.1	29	May/1990	154.1	77	May/1994	187.2
5	May/1988	136.0	53	May/1992	165.8	30	June/1990	153.5	78	June/1994	190.1
6	June/1988	137.5	54	June/1992	164.6	31	July/1990	148.9	79	July/1994	185.8
7	July/1988	134.1	55	July/1992	166.0	32	August/1990	157.4	80	August/1994	193.8
8	August/1988	138.7	56	August/1992	166.3	33	September/1990	145.6	81	September/1994	185.9
9	September/1988	131.9	57	September/1992	160.6	34	October/1990	151.5	82	October/1994	189.7
10	October/1988	133.8	58	October/1992	168.7	35	November/1990	156.1	83	November/1994	194.7
11	November/1988	140.2	59	November/1992	167.26	36	December/1990	179.7	84	December/1994	233.3
12	December/1988	171.0	60	December/1992	204.1	37	January/1991	130.9	85	January/1995	167.0
13	January/1989	122.5	61	January/1993	148.4	38	February/1991	128.6	86	February/1995	164.0
14	February/1989	118.9	62	February/1993	145.0	39	March/1991	149.3	87	March/1995	192.1
15	March/1989	141.3	63	March/1993	164.6	40	April/1991	148.5	88	April/1995	187.5
16	April/1989	139.8	64	April/1993	170.3	41	May/1991	159.8	89	May/1995	201.4
17	May/1989	150.3	65	May/1993	176.1	42	June/1991	153.9	90	June/1995	202.6
18	June/1989	149.0	66	June/1993	175.7	43	July/1991	154.6	91	July/1995	194.9
19	July/1989	144.6	67	July/1993	177.7	44	August/1991	159.9	92	August/1995	204.2
20	August/1989	153.0	68	August/1993	177.1	45	September/1991	146.7	93	September/1995	192.8
21	September/1989	144.1	69	September/1993	171.1	46	October/1991	152.1	94	October/1995	194.0
22	October/1989	142.3	70	October/1993	176.4	47	November/1991	155.6	95	November/1995	202.4
23	November/1989	148.8	71	November/1993	180.9	48	December/1991	181.0	96	December/1995	238.0
24	December/1989	176.5	72	December/1993	218.3						
25	January/1990	132.6	73	January/1994	154.6						

Problem Definition: Using the data through 1994, perform a decomposition analysis of this series. Forecast retail sales for 1995 and compare your results with the actual values provided in the table.

Question 1: The trend line equation is $Yt = 128.814 + .6737xt$. Yt stands for the time that we want to forecast for and after evaluating the equation, it appears that the average increase in sales over the long run is .6767 billion dollars.
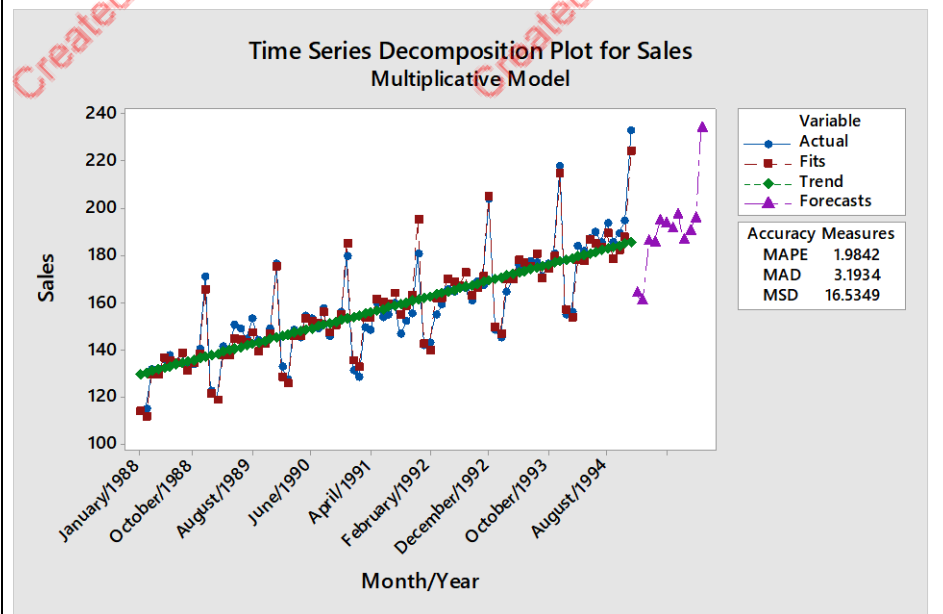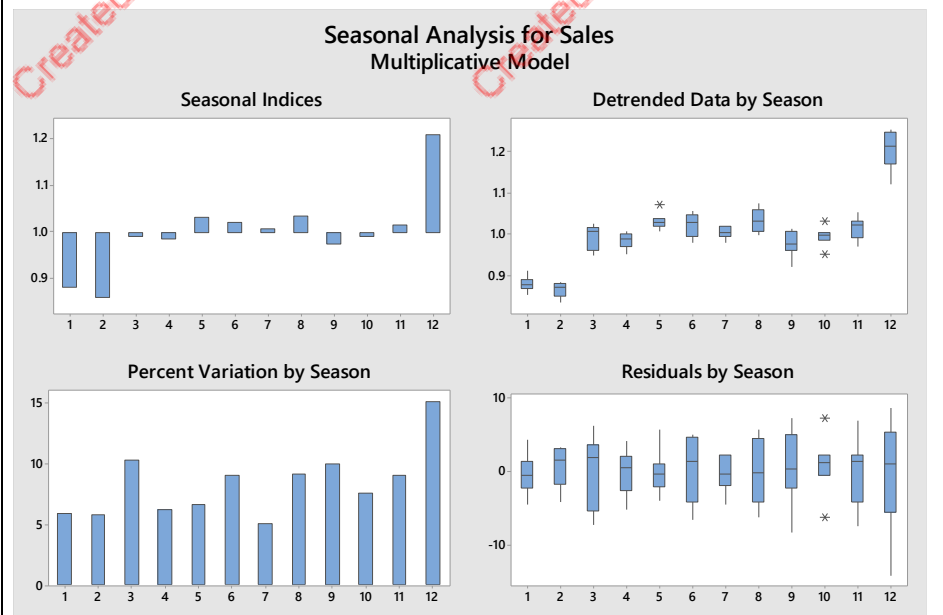
Fitted Trend Equation

$Yt = 128.814 + 0.6767 \times t$

Question 2: The original data graph shows a nonlinear trend going up and is also known as TSCI. It also shows seasonality due to constant peaks and dips. The detrended data graph shows clear signs of seasonality, over and underestimation due to the trend being removed and continually crossing the 1.0 line. Detrended data is also known as SCI which equals (SCI = Y/T) because the trend was removed. The seasonally adjusted data graph shows a clear trend increasing steadily up because the seasonally had been removed and is equal to (Yt/St = Tt*It). The seasonally adjected and detrended data shows large underestimation and then over estimation due to a negative drop and then positive incline. The graph is partially acceptable for handling the data well, but the massive negative drop and then positive climb doesn't make the graph the best predictor for monthly sales but for those reason is partially acceptable. Seasonally adjected and detrended data is also known as CI which equal to (CI = Y/TS).

Component Analysis for Sales — Multiplicative Model (Original Data, Detrended Data, Seasonally Adjusted Data, Seas. Adj. and Detr. Data)

The seasonal indices graph shows low sales in months 1 – 4 with months 3 and 4 being only slightly low. Next four months show an increase while month 7 only shows a slight increase. Months 9 and 10 show a decrease in sales but then a light increase in moth 11 and then a lighter spike in sales in moth 12. The detrended data by season graph shows a match to the graph variation in percent variation by season which show seasonal periods with the greatest and smallest variation using boxplots. Percentage variation by season is just a quantifier for the variation in each seasonal period which in our case show that month 12 had the most variation and month 7 had the least variation. Months 3 and 9 followed behind month 12 with have most variation but less than month 12, and months 1 and 2 followed month 7 with slightly a little more variation but still very little. The residuals by season shows no effect on the seasons of the residuals which regulate if seasonal effect is taking place on the residuals.

Seasonal Analysis for Sales
Multiplicative Model

Seasonal Indices

Detrended Data by Season

Percent Variation by Season

Residuals by Season

The time series decomposition plot for sales show a fit that models the data very closely. The plot shows an upward trend and that the model is nonstationary. The fit line does show underestimate and overestimation with a MAPE value of 1.9842 and a MAD value of 3.1934. This means the fits line could be off by roughly 3.2 billion dollars a any given point. Overall, with slight approximation error the plot fits the data even with its seasonality and trend.

Time Series Decomposition Plot for Sales
Multiplicative Model

Variable
Actual
Fits
Trend
Forecasts

Accuracy Measures
MAPE   1.9842
MAD   3.1934
MSD   16.5349

Sales

Month/Year

Question 3: After evaluating the forecasted revenue for 1995 and comparing them to the actual values for 1995 we can see that the forecasted values are consistently underestimating for every month of 1995. Looking at the MAPE (mean absolute percentage error) value of 1.9842 which shows us the accuracy of the forecast, we can tell how close we are to the actual observed values of our plot. Looking at the MAD (mean absolute deviation) value of 3.1934 we can see that out forecasts could be off by approximately plus or minus 3.2 billion dollars, this is importance since it shows us the magnitude of the forecast errors. While the MSD (mean squared deviation) of 16.5349 shows us the deviation and how close it is to zero, it is important to know due its key roll in the use of techniques or procedure that can yield modest error may be favored over ones that yield smaller error but seldomly yield larger ones. Overall, we see that the forecast is consistently underestimating future values but is acceptable due to the accuracy levels of the MAPE, MAD, and MSD being as low as they are. We can conclude that our forecast is accurate in predicting future profits.

Data

Row	Month/Year	Sales	FORE1
1	January/1995	167.0	164.010
2	February/1995	164.0	160.690
3	March/1995	192.1	186.071
4	April/1995	187.5	185.751
5	May/1995	201.4	194.920
6	June/1995	202.6	193.648
7	July/1995	194.9	191.802
8	August/1995	204.2	197.684
9	September/1995	192.8	186.590
10	October/1995	194.0	190.611
11	November/1995	202.4	196.085
12	December/1995	238.0	234.453

Accuracy Measures

MAPE	1.9842
MAD	3.1934
MSD	16.5349

$$\hat{Y} = T \times S \times C \times I$$

$$\hat{Y}_{85} = (128.814 + .6767 \times 85) \times .8802 \times 1.0 \times 1.0$$

$$\hat{Y}_{85} = 164.0107$$