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Project Data Analytics with Time-Series

**SECTION 1: Woodstock Temperature**

**Data Transformation**

* 1. Read in the Woodstock data and transform it into an appropriate time series datatype.

Output:

Qtr1 Qtr2 Qtr3 Qtr4

1988 -14.31801288 -10.18973430 -5.44745029 4.50567584

1989 6.88937495 12.11237739 13.55746347 13.80461938

1990 10.51213955 4.92773131 0.98999842 -4.14313710

1991 -13.35171600 -5.90648205 -4.26219804 0.59856382

1992 9.86423857 15.04349588 15.00015906 15.09864082

1993 13.61870679 8.17663986 2.84506785 -4.94390107

1994 -7.80265774 -9.69798659 -0.44782179 3.82406359

1995 8.33982348 13.65369575 15.90312386 14.65752574

1996 8.35494417 6.47965609 2.77998664 -5.32790958

1997 -9.25996470 -13.69588844 -0.54803834 2.24040852

1998 12.87452113 9.88374771 15.70557254 16.50231098

1999 13.38927047 4.08473945 0.97544694 -6.11549580

2000 -11.69653262 -9.00612707 -4.87390516 -1.45409572

2001 9.71366341 13.32941847 14.07068692 12.98536549

2002 12.64097398 2.15022827 -1.39516653 -5.82862151

2003 -8.86633831 -7.69678862 -5.27401746 0.90381646

2004 7.77785667 10.81962002 14.53196321 12.67117507

2005 13.76698323 3.15512391 -0.41384539 -5.11329804

2006 -9.81207562 -8.40186016 -2.22063012 3.97365558

2007 9.59603693 14.41461629 11.93170570 12.48369345

2008 10.46827032 5.22764882 -1.33722841 -3.98447211

2009 -11.37625644 -6.96433688 -2.06355466 4.04778296

2010 11.58552464 15.36710268 17.46939189 15.48865227

2011 9.80148833 3.59201234 -1.16393491 -2.36265735

2012 -11.70596267 -8.13718822 -6.48011774 6.10097678

2013 11.07796676 12.70744346 14.47380298 13.20667251

2014 11.77419878 7.25685307 -0.76913721 -5.60367457

2015 -5.50449215 -5.90070667 -2.39552278 1.74182239

2016 6.32428650 14.71789945 15.18320960 19.88383729

2017 13.12274374 10.14989331 1.20590859 -1.26684035

2018 -9.10003239 -8.51135671 -3.30266936 0.58014264

2019 10.18419993 15.68737279 15.83541985 16.29805252

2020 8.15630762 6.67076439 3.24531060 -1.99731486

2021 -7.34980343 -7.14257074 -3.48657782 1.36190754

2022 11.59422896 13.51946332 20.66289214 13.14305210

2023 15.49591293 9.31794510 3.95239045 0.71553919

2024 -7.98183457 -3.81322103 -3.62511506 1.28014368

2025 9.67184825 14.98966929 21.47999516 17.50023832

2026 15.77043353 10.20084659 4.37643343 -6.00320850

2027 -5.75770596 -6.95350686 -3.61552052 2.25252529

2028 7.51569197 14.15896284 19.35184528 14.99001711

2029 14.13141061 6.67276625 4.48745916 0.08566565

2030 -9.28544435 -8.63940629 1.75218362 3.48505107

2031 5.67007577 15.61849549 17.25383188 15.24257942

2032 10.58610210 10.26216613 0.48193521 -1.25513328

2033 -8.02228610 -3.78628217 3.13825367 3.12511857

2034 10.48494283 14.36272506 17.77336209 15.42997101

2035 13.37976645 8.99005828 2.84998721 -4.28945227

2036 -8.76769695 -9.99782289 -0.24834333 5.34845126

2037 13.22541441 13.88804683 18.76996823 18.49646653

2038 13.96676649 7.88413133 4.25658805 -3.10202588

2039 -3.84314282 -4.94854772 -3.89994811 2.23210028

2040 8.35016455 16.73210118 18.70412966 18.19604491

2041 15.76060248 10.23999695 3.68239129 -0.21158126

2042 -4.91006768 -3.29145430 2.98437215 3.69069743

2043 9.62313802 15.22166014 20.21181122 17.37733462

2044 12.70479673 10.30397356 0.69153010 -2.35263374

2045 -8.39024527 -5.33100822 0.49314905 4.74417997

2046 11.54639230 15.77383358 15.27436916 16.04974783

2047 10.84558456 11.59321728 4.11745356 -4.38485247

2048 -6.33224397 -5.81586241 0.43544051 5.96679984

2049 10.56825921 15.56203531 14.69751392 20.63465958

2050 13.26435526 10.05410754 2.73877289 -2.42941105

2051 -3.64849481 -6.13701555 -1.53202897 4.01546243

2052 12.81059844 14.46031020 19.67536280 17.02437483

2053 17.85198219 7.01784415 4.06771663 0.31975851

2054 -2.94989422 -3.62211089 2.30663379 4.53191146

2055 10.74703977 17.43651490 19.49151864 17.49795360

2056 17.10195970 5.58623316 3.97787025 -1.30733744

2057 -4.81516572 -5.31244815 1.77565175 5.36294385

2058 13.86198651 18.27628807 23.11805894 16.89739627

2059 16.16321577 7.30820372 3.02903755 2.01108042

2060 -5.47248825 -4.24366363 0.11841725 9.22811038

2061 10.96397426 13.52285041 16.60426338 15.31269986

2062 14.84289121 5.59080566 5.27316489 -1.19886404

2063 -4.66148285 -2.73071011 0.03252215 3.07284898

2064 11.85120714 18.38744283 18.44169894 16.53234207

2065 15.91964442 6.76597966 3.61841179 -1.29172628

2066 -3.01993387 -7.15887538 2.35674144 7.17131693

2067 12.21829188 12.95528334 18.66742840 19.34557433

2068 14.43207908 6.64898874 3.09187457 0.72816522

2069 -7.48889097 -4.11489959 2.96394672 3.65315782

2070 10.39111951 16.73216945 14.81663083 18.49894867

2071 14.56210196 5.98829007 2.44925231 0.57165896

2072 -9.32588222 -5.89529523 2.16143011 2.71726738

2073 14.68946009 20.00044744 21.32752242 15.61357205

2074 14.28684327 15.48835516 4.88594303 0.10198560

2075 -6.32468891 -3.43232385 -0.19948435 1.34170457

2076 14.91804605 16.92476434 18.40872233 15.31847712

2077 16.87940334 9.81922732 4.24311142 -1.22757705

**Descriptive Data Analysis**

2.1) Summarize the temperature information (mean, etc.)

Output:

Min. :-14.318

1st Qu.: -1.474

Median : 5.311

Mean : 5.654

3rd Qu.: 13.869

Max. : 23.118

2.2) Plot the time series data.

Output:

A picture containing chart

Description automatically generated

2.3) Decompose the times series data into the constituent components. Comment on each (any trends you observe, etc.)

Output: The values are in code, presenting values using plot.

Graphical user interface

Description automatically generated with medium confidence

Comment: Observe

The seasonal component is surged in the end of then every year and lower in the middle of the year and there is no upward trend.

Trend is constantly going up and down.

In random observations it is showing dramatic fluctuation in temperature, the cycle of increase and decrease over the years and showing a constant trend

2.4) Determine if the time series is stationary.

Output: Augmented Dickey-Fuller Test

data: TempStudy1\_PP

Dickey-Fuller = -13.173, Lag order = 7, p-value = 0.01

alternative hypothesis: stationary

Because the p-value is far lower than the 0.05 significance level, we can reject the null hypothesis and assume that the series is stationary.

2.5) Deseasonalize the information and plot the result.

Output:

A picture containing graphical user interface

Description automatically generated

2.6) Add any comments about what you observe: seasonality of temperature, trends, etc.

Output: The temperature in woodstock showing the violent fluctuation between several years, it surges and plunge with constant trend

The time series is stationary. There is an upward and downward trend, but it is constant.

**SECTION 2: Ayr Temperature**

**Data Transformation**

* 1. Read in the Ayr data and transform it into an appropriate time series datatype.

Output

Time Series:

Start = 1968

End = 2003

Frequency = 1

Temp

[1,] 11.20966

[2,] 12.85350

[3,] 12.10332

[4,] 10.98670

[5,] 12.78706

[6,] 12.47640

[7,] 11.62350

[8,] 12.80770

[9,] 12.32183

[10,] 11.05027

[11,] 12.78073

[12,] 12.70647

[13,] 11.68255

[14,] 12.43678

[15,] 12.45112

[16,] 11.82961

[17,] 12.81172

[18,] 12.99576

[19,] 12.04528

[20,] 12.73789

[21,] 12.75333

[22,] 12.37577

[23,] 13.71008

[24,] 12.95345

[25,] 12.64085

[26,] 13.30555

[27,] 12.99537

[28,] 11.90528

[29,] 13.98229

[30,] 13.01111

[31,] 12.61607

[32,] 13.38989

[33,] 12.67542

[34,] 12.82055

[35,] 13.39611

[36,] 13.46360

**Descriptive Data Analysis**

2.1) Summarize the information (mean, std dev, etc.)

Output:

Min. :10.99

1st Qu.:12.27

Median :12.72

Mean :12.57

3rd Qu.:12.96

Max. :13.98

2.2) Plot the time series data.

Chart

Description automatically generated

2.3) Smooth the temperature chart using a moving average, Try 3 different values for the moving average and choose the one you think best shows the trend (if any).

: Below image depicts temperature chart using a moving average with value 10

Chart, line chart, histogram

Description automatically generated

Below image depicts temperature chart using a moving average with value 1Chart

Description automatically generated

Below image depicts temperature chart using a moving average with value 7Chart, line chart, histogram

Description automatically generated

Comment:

Accordingly, if the value is less then we can observe graph trend sharply whereas greater value not give a clear picture, it shows some steadiness in middle of the trend.

2.4) Determine if the time series is stationary.

Output: Augmented Dickey-Fuller Test

data: TempStudy\_2

Dickey-Fuller = -3.2533, Lag order = 3, p-value = 0.09458

alternative hypothesis: stationary

The resulting p-value is greater than the 0.05 significance level.

There is no reason to reject the null hypothesis, as far as I can tell. As a result, the time series is non-stationary.

2.5) Create an autocorrelation chart (using acf) and comment on which lags are significant. Do previous values seem to influence current values?

Output:

Chart

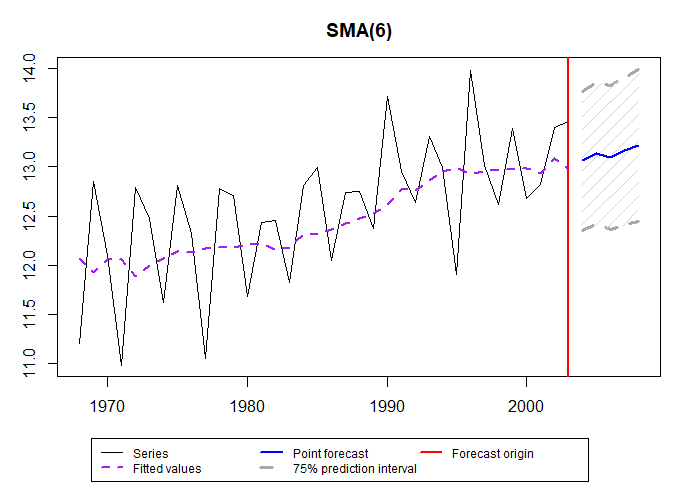
Description automatically generated

Comment: Significant values are those that are above the blue line. All the Significant values lies before 12 lags ( including 12th)

This implies that contemporary values are more closely linked to outcomes than earlier values.

3.1) Create a simple moving average forecast of temperature in Ayr for five years beyond the data provided. Graph your results along with a 75% prediction interval.

Output:



3.2) Create an exponentially smoothed forecast of temperature in Ayr for five years beyond the data provided. Graph your results along with a 75% prediction interval.

Output:

Chart, line chart

Description automatically generated

3.3) Compare the two forecasts you created in steps 1 and 2 above. Which forecast seems superior? Why?

Output:

After Comparison of both simple moving average forecast and exponentially smoothed forecast some point to be observed:

* The trend in both the forecast is upwards
* The exponentially smoothed forecast is superior it is showing ideal upward trend whereas
* Simple moving average forecast is steady sometime, suddenly go up and again plunge this cycle is repeating with constant upward trend.