February 28, 2019
Dennis Jackson
5196 Pioneer Road
Medford, OR 97501

Oregon State Legislature
Joint Committee on Carbon Reduction
Salem, Oregon 97301

jccr.exhibits@oregonlegislature.gov

Re: HB2020 Work Session, Medford, Oregon, 2/23/2019

Dear Co-Chair Dembrow and Co-Chair Power;

Thank you for holding a public hearing on HB-2020 in Medford, OR on Saturday February 23, 2019. I attended the meeting but was one of the 34 speakers remaining when you closed the meeting at 1:00 pm. Thank you for the gracious way you conducted the meeting. I was very impressed with how respectfully you treated each speaker. And thank you for traveling to Medford to take public input on HB-2020.

My name is Dennis Jackson. I live in Jackson County just to the southwest of Medford. My wife and I moved into our house in the fall of 2013. My wife and I support HB-2020.

There are three parts to my comments. First, I will address concerns I have about Climate Change induced by Global Warming. Second, in an appendix, I will present a statistical analysis of the Medford Airport temperature record to demonstrate that Global Warming has been occurring in the Medford area for a significant length of time.

Concerns

I am a retired surface water hydrologist. I spent most of my career working on environmental issues in Napa County, Sonoma County, Mendocino County and Santa Cruz County. These California Counties have Mediterranean Climates with cool-wet winters and warm-dry summers. The vegetation in these four Counties ranges from grasslands to oak woodlands to coniferous forest. Except for Santa Cruz, most of the population of these counties live in mountain valleys. In a broad physiographic way, these counties are like Jackson County, Oregon.

We bought our house in August of 2013. Wildfires were raging that summer and the smoke from those fires made house-hunting more stressful. The smoke was very thick on the day we bought our house. We could not see across the yard that day. The smoke gave us pause, but our realtor and other people we talked to assured us that the smoke was not normal.

Over the last six years Oregon has been subjected to the smoke from a series of large wildfires, several of which exceeded 100,00 acres in size (mega-fires). Some of the smoke came from fires in California. Some of the smoke came from other western states. And some of the smoke came from as far away as British Columbia and Alberta Canada. Most large wildfires burn a mix of vegetation types. Some large wildfires do not burn any commercial timberland. Therefore, the term wildfire is preferred over forest fire because it is more general.

These fires occurred against a backdrop of drought and increased summer temperatures across the Oregon, the western United States and western Canada (see the US Drought Monitor link below). Several of these fires occurred during periods of high wind such as California's Camp Fire where winds were blowing over 50 mph before the fire broke-out. Very large fires create their own wind. But often the events that change small fires into very large fires involve high winds. These fires burned a mix of vegetation types including grassland, chaparral, oak woodland, non-commercial forest, and commercial forests. It is overly optimistic to think that changes in forest management can significantly limit the number and size of wildfires.

- Drought cannot be controlled by forest management.
- High winds cannot be controlled by forest management.
- High summer temperatures cannot be controlled by forest management.
- Low humidity in the summer and fall can not be controlled by forest management.

These factors are adversely affected by global warming. Global warming can only be addressed by significantly cutting emissions from fossil fuels and increasing the ability of natural systems to absorb more carbon dioxide from the atmosphere.

Build-up of fuels in grasslands, chaparral and shrub lands, oak woodlands and non-commercial forest cannot be controlled by commercial forest management. However, the build-up of fuel in non-commercial forest areas could accomplished by a very large expenditure of public money. Unlike commercial forests there is little if any marketable products that would be produced by wildfire fuel reduction on non-commercial land.

Figure 1 below shows the annual total acres burned in the United States. Note that in the 17 years prior to 2000 the total annual burned area exceeded 6,000,000 acres in only one year, or 6% of the years. In contrast, in the 19 years from 2000-2018, the burned area exceeded 6,000,000 acres in 11 years, or 58% of the years.

The annual number of days in each USEPA Air Quality Index (AQI) class for Jackson County Oregon from 2000 to 2018 is shown in Table 1 below. The annual maximum AQI for each year is also shown in Table 1. The maximum annual USEPA Daily Air Quality Index (AQI) for Jackson County Oregon was greater than 200 in four of the last six years. An AQI between 200 and 300 is classed as *Very Unhealthy* and over 300 is classed as *Hazardous*. The maximum AQI in 2017 was 356.

Smoke from wildfires can cause or exacerbate serious health issues in sensitive groups and even affect healthy people if the smoke is thick enough. The Oregon Health Authority, Public Health Division, Climate and Health Program produced a report entitled, *Oregon Climate and Health Profile Report* (see link below). The Executive Summary of the Report notes the following health impacts from Climate Change.

- Changes are likely to lead to health impacts from drought, deteriorating air quality, wildfires, heat waves, water-borne disease, increased allergens and diseases spread by ticks and mosquitoes
- Climate change could also increase and worsen chronic diseases such as asthma and mental health issues such as depression and anxiety.
- Air pollution from increased ground-level ozone and wildfire smoke could worsen respiratory illness.
- Water sources can become contaminated from drought or flooding.

- Drought in Oregon or elsewhere could cause food insecurity, especially among vulnerable populations.
- Hospitalizations increase during extreme heat events.
- Wildfire smoke is a problem in many communities.
- In many rural communities, drought threatens family incomes and quality of life.

Plants will also be adversely affected by climate change. Photosynthesis depends on temperature, pH, light intensity and other factors. At temperatures between 32^0 and 50^0 F photosynthesis is inefficient. Between 50^0 and 68^0 F, the enzymes involved in photosynthesis work at their optimal level. At temperatures between 68^0 and 104^0 F, the efficiency of photosynthesis decreases. At 104^0 F, the enzymes involved in photosynthesis begin to lose their shape and the rate of photosynthesis rapidly declines. Global warming is increasing the duration of high summer temperatures.

High summer temperatures also adversely impact agricultural crops. For example, wine grapes can be adversely impacted when temperatures exceed 95^0 F (see heat stress on grapes link below). Many vegetable crops are also adversely affected by high temperature. For example, tomatoes are impacted by consistent temperatures above 90^0 F. Tomatoes are also affected when nighttime temperatures stay above 75^0 F. Douglas-fir and other coniferous trees are impacted by heat stress

The Statistical Analysis of the Medford Airport Temperature Data that follows my comments shows that Global Warming has increased temperatures in Southern Oregon over a 91-year period from 1928 to 2018. Global Warming is not something that is going to happen many years from now. Global Warming is happening now in Medford, Oregon. In addition to the Medford Airport temperature data, the large catastrophic fires that have occurred around the west in the last few years are also evidence for global warming induced climate change.

Oregon will directly experience adverse impacts from climate change including additional large wildfires and the suffocating smoke that is a health risk to everyone in the state. Climate change will continue to cause summertime temperatures to increase. This is a concern especially in Southern Oregon and Eastern Oregon. Increased summer temperatures have health consequences especially for the elderly. And increased temperatures stress agricultural plants and forest trees.

Climate change is happening now. Oregon is currently suffering from the adverse impacts of climate change.

Directions

Fossil fuels permeate most facets of modern culture. Ways must be found for people to make a decent living while reducing greenhouse gas emissions. And opportunities must be created for people to make a decent living sequestering carbon through new agricultural practices, forestry practices targeted to accumulating carbon, or homeowners to build soil health, thereby sequestering carbon.

Reduction in the use of chemical fertilizers and pesticides are also an important step. The production of these chemicals emits greenhouse gasses and they adversely impact soil health. Healthy soil is one of the largest carbon sinks on the planet. According to the Yale School of Forestry and Environmental Studies (see link below):

> Scientists say that more carbon resides in soil than in the atmosphere and all plant life combined; there are 2,500 billion tons of carbon in soil, compared with 800 billion tons in the atmosphere and 560 billion tons in plant and animal life. And compared to many proposed

geoengineering fixes, storing carbon in soil is simple: It's a matter of returning carbon where it belongs.

Please consider drafting additional legislation to help people reduce atmospheric greenhouse gases while making a decent living.

We support HB-2020 but view it as only an important step towards Oregon's essential goal of reducing atmospheric greenhouse gases. HB 2020 is an important step in reducing Oregon's emissions of greenhouse gases. However, other steps must be taken to reduce greenhouse gases that are currently stored in the atmosphere. To drawdown the greenhouse gases stored in the atmosphere it is necessary to simultaneously reduce emissions and to increase the absorption of carbon and other greenhouse gas in appropriate sinks such as the soil and plants.

Thank you for your careful consideration of this issue.

Sincerely,

Dennis Jackson

cc: Senator Jeff Golden
Representative Pam Marsh

Table 1. *The annual number of days in each USEPA Air Quality Index (AQI) class for Jackson County Oregon from 2000 to 2018.*

Source:https://www.epa.gov/outdoor-air-quality-data/air-quality-index-daily-values-report

	Good	*Moderate*	*Unhealthy for Sensitive Groups*	*Unhealthy for Sensitive Groups*	*Very Unhealthy*	*Hazardous*	*Annual Maximum AQI*
Year	**0-50**	**50-100**	**100-150**	**150-200**	**200-300**	**>300**	
2000	**246**	**96**	**21**	**1**	**0**	**0**	**151**
2001	**246**	**112**	**6**	**0**	**0**	**0**	**127**
2002	**190**	**147**	**20**	**5**	**0**	**0**	**158**
2003	**83**	**41**	**3**	**0**	**0**	**0**	**129**
2004	**251**	**103**	**8**	**0**	**0**	**0**	**114**
2005	**254**	**101**	**9**	**1**	**0**	**0**	**151**
2006	**259**	**103**	**3**	**0**	**0**	**0**	**139**
2007	**263**	**99**	**3**	**0**	**0**	**0**	**119**
2008	**243**	**116**	**7**	**0**	**0**	**0**	**143**
2009	**264**	**91**	**8**	**2**	**0**	**0**	**171**
2010	**305**	**60**	**0**	**0**	**0**	**0**	**85**
2011	**263**	**95**	**5**	**0**	**0**	**0**	**121**
2012	**261**	**103**	**2**	**0**	**0**	**0**	**110**
2013	**213**	**128**	**13**	**9**	**2**	**0**	**238**
2014	**267**	**95**	**3**	**0**	**0**	**0**	**121**
2015	**252**	**83**	**18**	**11**	**1**	**0**	**284**
2016	**303**	**63**	**0**	**0**	**0**	**0**	**81**
2017	**249**	**86**	**15**	**9**	**4**	**2**	**356**
2018	**211**	**49**	**12**	**27**	**4**	**0**	**233**

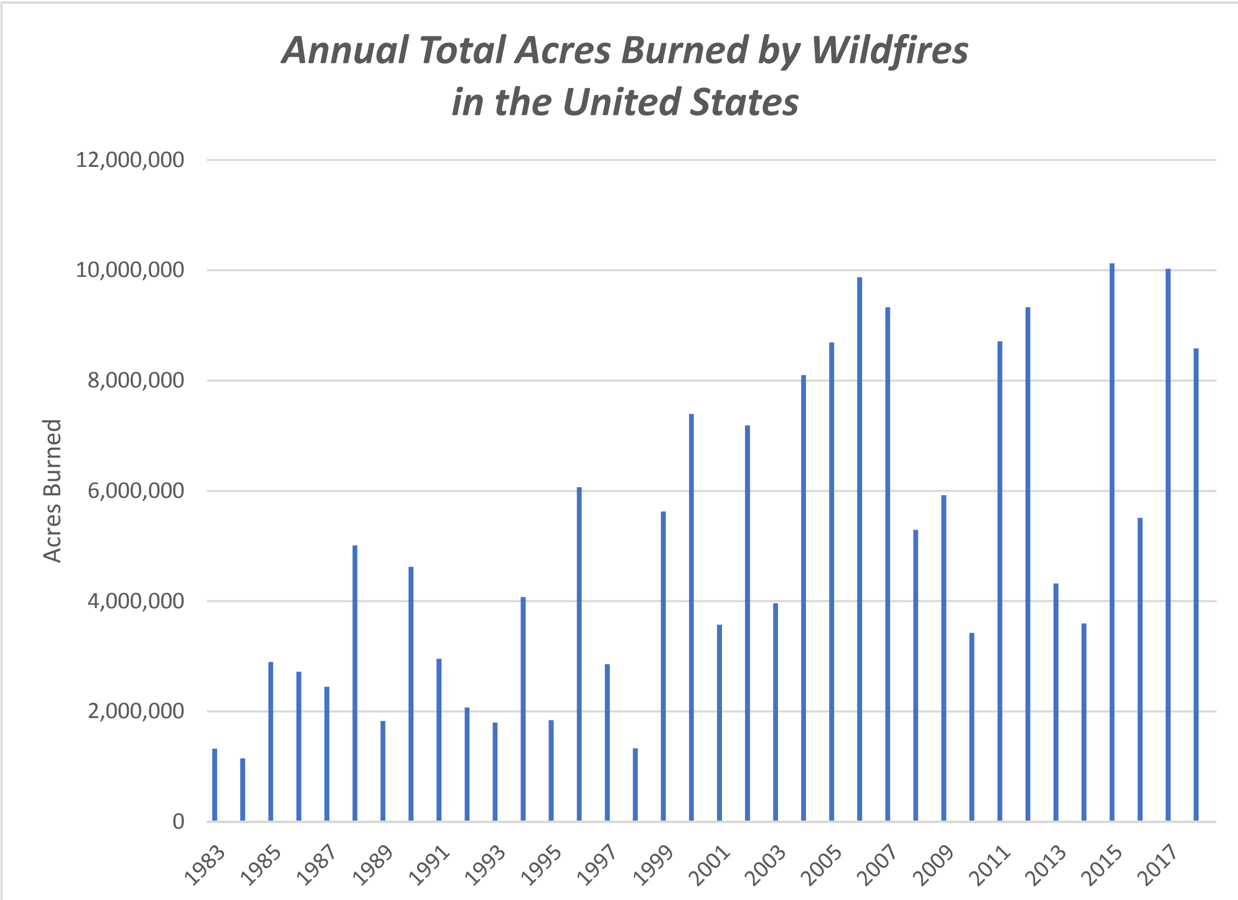


Figure 1. Annual total acres burned in the United States. Note that in the 17 years prior to 2000 the total annual burned area exceeded 6,000,000 acres only in one year, or 6% of the years. In contrast, in the 19 years from 2000-2018, 11 years exceeded 6,000,000 acres, or 58% of the years.

Source: National Interagency Coordination Center
https://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html

References:

Oregon Health Authority
www.healthoregon.org/climatechange

Oregon Climate and Health Profile Report

https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/oregon-climate-and-health-profile-report.pdf

State Cap-and-Trade systems

https://www.greenbiz.com/article/state-cap-and-trade-systems-make-case-carbon-pricing

EPA Air Quality Index (AQI)

https://www.epa.gov/outdoor-air-quality-data/air-quality-index-daily-values-report

Heat stress on grapes

https://www.farmprogress.com/grapes/tips-minimize-heat-stress

Yale School of Forestry and Environmental Studies. Soil as a carbon sink.

https://e360.yale.edu/features/soil_as_carbon_storehouse_new_weapon_in_climate_fight

US Drought Monitor

https://droughtmonitor.unl.edu/

Summary of a Statistical Analysis of the Medford Airport Weather Data, 1928-2018 Medford, Oregon

Daily temperature and precipitation records for the Medford Rogue Valley International Airport, Medford Oregon were obtained from NOAA's Climate Data Center website *https://www.ncdc.noaa.gov/*. The station number is USW00024225.

A total of 91-years of record were available, spanning January 1, 1928 through December 31, 2018. Only the temperature data is address in this Summary. The temperature data consists of a daily maximum and minimum temperature. For each day, the maximum and minimum temperatures were averaged to give an estimate of the daily average temperature. The temperature data is in degrees Fahrenheit. The statistical analysis was done using Microsoft Excel.

Annual average carbon dioxide (CO_2) data was obtained from www.epa.gov/climate-indicators. Only 68 years between 1928 and 2018 had annual average CO_2 data available. Only 8 years had CO2 data in the 31-year period from 1928 to 1958. Average annual carbon dioxide concentration data was only available for about 75% of the 1928 to 2018 period.

The first set of analyses used simple linear regression to determine if there was a change in the mean annual maximum temperature; the annual average temperature; and the mean annual minimum temperature with increasing carbon dioxide concentration. The results for the annual analysis are given in Table 1 and shown in Figure 2. A similar analysis was done for each month of the year. The results for the monthly regressions of temperature versus carbon dioxide concentration are shown in Table 1 and in Figures 3-14. The measure of statistical significance for these linear regressions was set to a p-value of less than 0.01. That is, the slope of the regression line is judged to be significantly different from zero if the p-value for the slope is less than 0.01. The slope of the regression line is a direct measure of the rate of change of the dependent variable versus the independent variable. For example, in Table 1, the slope of the linear regression of the mean maximum temperature for January versus CO_2 concentration is shown to be 0.0735 and the p-value is 0.0001. Since the p-value for January is less than 0.01 the slope of 0.0735 is significant. This slope means that an increase of CO2 concentration of 100 ppm is expected to result in an increase of 7.35 degrees in the January mean monthly maximum temperature.

Table 1 shows that the annual mean maximum temperature, the annual average temperature and the annual mean minimum temperatures have statistically significant p-values. The positive slopes indicate that the three measures of annual temperature increasing with increasing CO_2 concentration.

Table 1 also shows that the mean monthly minimum temperatures from March through October all have positive slopes with significant p-values indicated that the mean monthly minimum temperature is increasing for those eight months. In contrast, the only mean monthly maximum temperature to have a statistically significant slope is January. The slope of the average monthly temperature is positive and statistically significant for seven months. The positive slopes indicate that the monthly average temperature is increasing with increasing CO_2 concentration for the months of January, March, May, and July-October.

The second set of analyses used simple linear regression to determine if there was a change in the mean annual maximum temperature; the annual average temperature; and the mean annual minimum temperature with increasing year. The results for the annual analysis are given in Table 2 and shown in Figure 15. A similar analysis was done for each month of the year. The results for the monthly regressions of temperature versus carbon dioxide concentration are shown in Table 2 and in Figures 16-27. The measure of statistical significance for these linear regressions was set to a p-value of less than 0.01. That is, the slope of the regression line is judged to be significantly different from zero if the p-value for the slope is less than 0.01. The slope of the regression line is a direct measure of the rate of change of the dependent variable versus the independent variable. For example, in Table 2, the slope of the linear regression of the mean maximum temperature for January versus year is shown to be 0.0588 and the p-value is 0.0000. Since the p-value for January is less than 0.01 the slope of 0.0588 is significant. This slope means that after 100 year, the January mean monthly maximum temperature is expected to increase 7.35 degrees.

Table 2 shows that the annual mean maximum temperature, the annual average temperature and the annual mean minimum temperatures have statistically significant p-values. The positive slopes indicate that the three measures of annual temperature increasing with increasing year. The annual mean minimum temperature is increasing at a rate of 3.87 degrees F per century. The other two annual temperature measures are increasing at a somewhat slower rate.

Table 2 also shows that the mean monthly minimum temperatures from March through November all have positive slopes with significant p-values indicating that the mean monthly minimum temperature is increasing over time for those nine months. In contrast, the mean monthly maximum temperature of January and June, July and August have positive statistically significant slopes. The mean maximum monthly temperatures for those four months are increasing between 3.7 degrees F and 5.9 degrees F per century. The slope of the average monthly temperature is positive and statistically significant for six months. The positive slopes indicate that the monthly average temperature is increasing at rates of about 4.1 to about 5.2 degrees F per century for the months of January, February, and June-September.

The third set of analyses used simple linear regression to determine if the number of days with temperatures greater than 90 degrees F was increasing annually and by month. The results are shown in Table 3 and in Figure 28-30.

Table 3 and Figure 28 show that the number of days greater than 90 degrees F, in a year, is increasing at a rate of 22.2 days per century. That is, the number of days with temperatures above 90 increased by about 3 weeks from 1928 to 2018.

Both July and August show a statistically significant increase in the number of days with temperatures greater than 90 degrees F. The number of days exceeding 90 degrees F in July is increasing at a rate of 8.4 days per century. The rate for August is 6.8 days per century.

The fourth set of analyses used simple linear regression to determine if the number of days with temperatures less than 32 degrees F was decreasing annually and by month. The results are shown in Table 3 and in Figure 31-32.

Table 3 and Figure 31 show that the number of days less than 32 degrees F, in a year, is decreasing at a rate of 27.1 days per century. That is, the number of days with temperatures below freezing decreased by about 4 weeks from 1928 to 2018.

Only November has a statistically significant decrease in the number of days below freezing. The number of days below freezing in November decreased at a rate of 7.8 days per century.

Conclusion

Each of the four analyses performed showed that the temperatures recorded at the Medford Rogue Valley International Airport, from 1928 to 2018, were increasing over time and with increasing CO_2 concentrations. These four analyses support the view that climate change is directly affecting temperatures in Southern Oregon.

Figure 1. Annual Global Average Carbon Dioxide Concentration, ppm

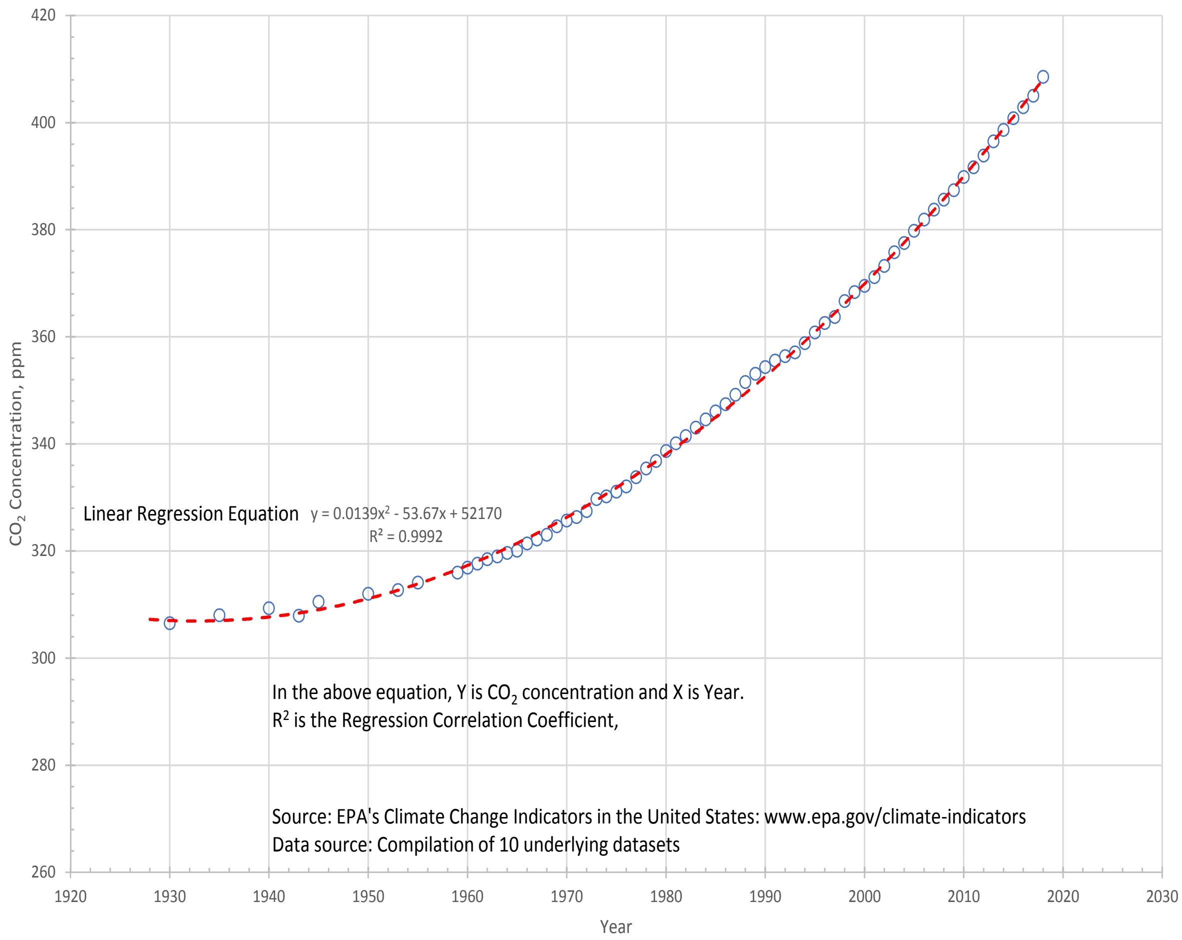


Table 1

Medford Airport Temperatures 1928-2018
Summary of Annual and Monthly Linear Regressions
Temperature vs Carbon Dioxide Concentration

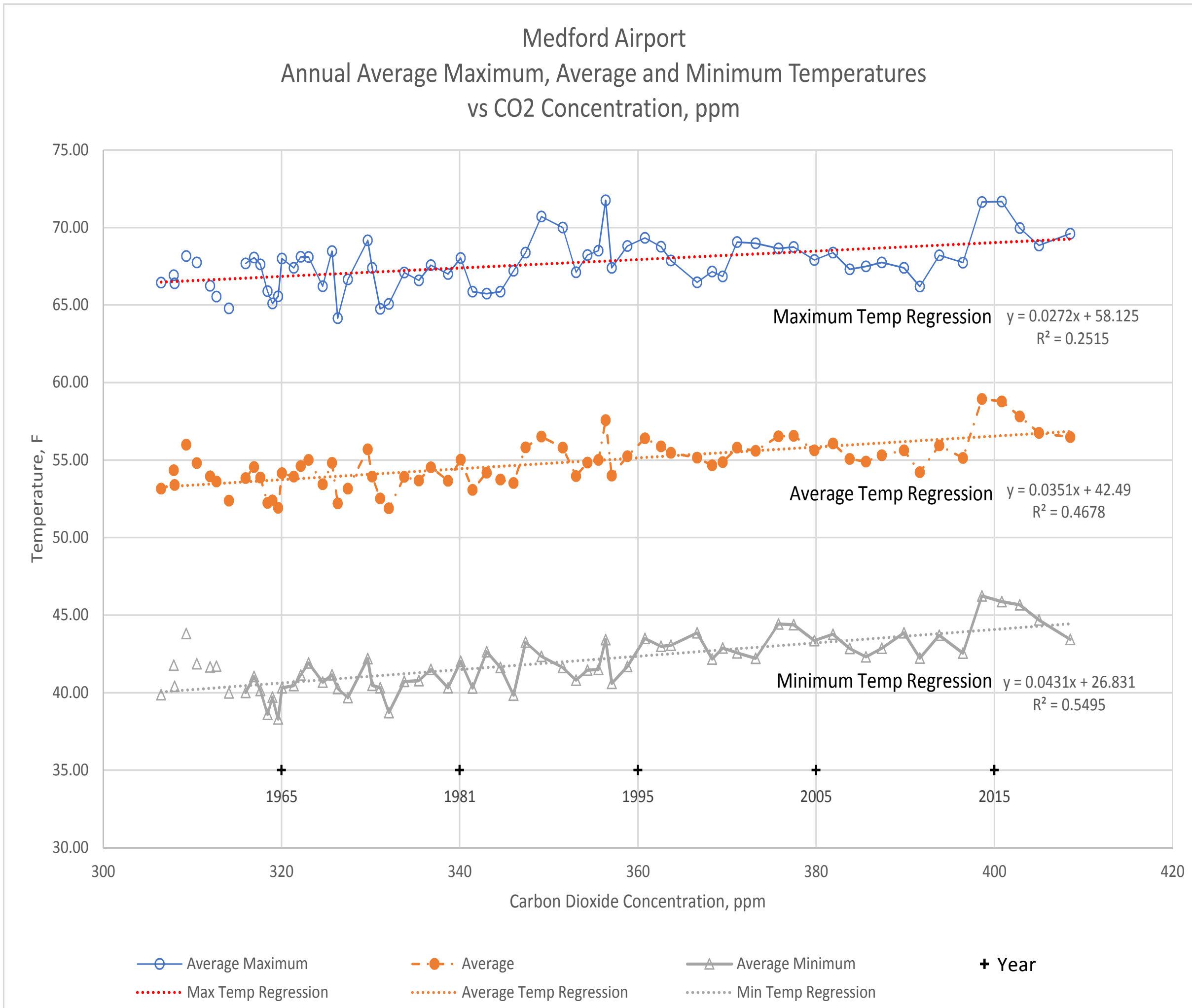
	Mean Maximum Temperature		
	Slope	**Intercept**	**R-SQ**
January	0.0735	-99.2146	0.2165
p-Value	**0.0001**	**0.0050**	
February	0.0280	-1.6371	0.0403
p-Value	*0.1006*	*0.9609*	
March	0.0272	4.7051	0.0287
p-Value	*0.1671*	*0.9036*	
April	0.0204	23.9760	0.0123
p-Value	*0.3682*	*0.5930*	
May	0.0516	-29.5315	0.0765
p-Value	*0.0224*	*0.5024*	
June	0.0191	43.7038	0.0131
p-Value	*0.3519*	*0.2843*	
July	0.0480	-4.3052	0.0898
p-Value	*0.0130*	*0.9085*	
August	0.0406	9.6968	0.0756
p-Value	*0.0233*	*0.7807*	
September	0.0295	24.9924	0.0225
p-Value	*0.2226*	*0.6006*	
October	0.0348	0.4288	0.0423
p-Value	*0.0925*	*0.9916*	
November	0.0206	12.3652	0.0247
p-Value	*0.2009*	*0.6969*	
December	0.0149	15.8861	0.0123
p-Value	*0.3671*	*0.6259*	
Annual	0.0232	21.6352	0.1509
p-Value	**0.0001**	0.0638	

	Average Temperature		
	Slope	**Intercept**	**R-SQ**
January	0.0580	-76.0834	0.1609
p-Value	**0.0007**	*0.0215*	
February	0.0234	-2.9834	0.0427
p-Value	*0.0907*	*0.9124*	
March	0.0398	-31.7132	0.1114
p-Value	**0.0054**	*0.2520*	
April	0.0357	-19.0709	0.0672
p-Value	*0.0328*	*0.5587*	
May	0.0660	-72.3222	0.2293
p-Value	**0.0000**	*0.0171*	
June	0.0388	-10.8446	0.0946
p-Value	*0.0107*	*0.7127*	
July	0.0707	-66.6317	0.2662
p-Value	**0.0000**	*0.0231*	
August	0.0583	-42.7289	0.2629
p-Value	**0.0000**	*0.0775*	
September	0.0435	-20.0733	0.1028
p-Value	**0.0077**	*0.5245*	
October	0.0376	-19.4931	0.1107
p-Value	**0.0056**	*0.4564*	
November	0.0280	-11.2420	0.0582
p-Value	*0.0475*	*0.6840*	
December	0.0092	20.1307	0.0044
p-Value	*0.5919*	*0.5564*	
Annual	0.0307	-5.9327	0.2989
p-Value	**0.0000**	0.5473	

	Mean Minimum Temperature		
	Slope	**Intercept**	**R-SQ**
January	0.0424	-52.9522	0.0681
p-Value	*0.0316*	*0.1710*	
February	0.0188	-4.3296	0.0208
p-Value	*0.2403*	*0.8910*	
March	0.0523	-68.1316	0.2061
p-Value	**0.0001**	**0.0084**	
April	0.0509	-62.1179	0.1635
p-Value	**0.0006**	*0.0307*	
May	0.0804	-115.1129	0.4233
p-Value	**0.0000**	**0.0000**	
June	0.0585	-65.3930	0.2467
p-Value	**0.0000**	*0.0109*	
July	0.0933	-128.9583	0.4285
p-Value	**0.0000**	**0.0000**	
August	0.0759	-95.1546	0.4050
p-Value	**0.0000**	**0.0001**	
September	0.0575	-65.1391	0.2130
p-Value	**0.0001**	*0.0186*	
October	0.0405	-39.4150	0.1185
p-Value	**0.0041**	*0.1482*	
November	0.0354	-34.8492	0.0545
p-Value	*0.0553*	*0.3365*	
December	0.0045	22.6815	0.0008
p-Value	*0.8231*	*0.5706*	
Annual	0.0381	-33.5967	0.3606
p-Value	**0.0000**	**0.0021**	

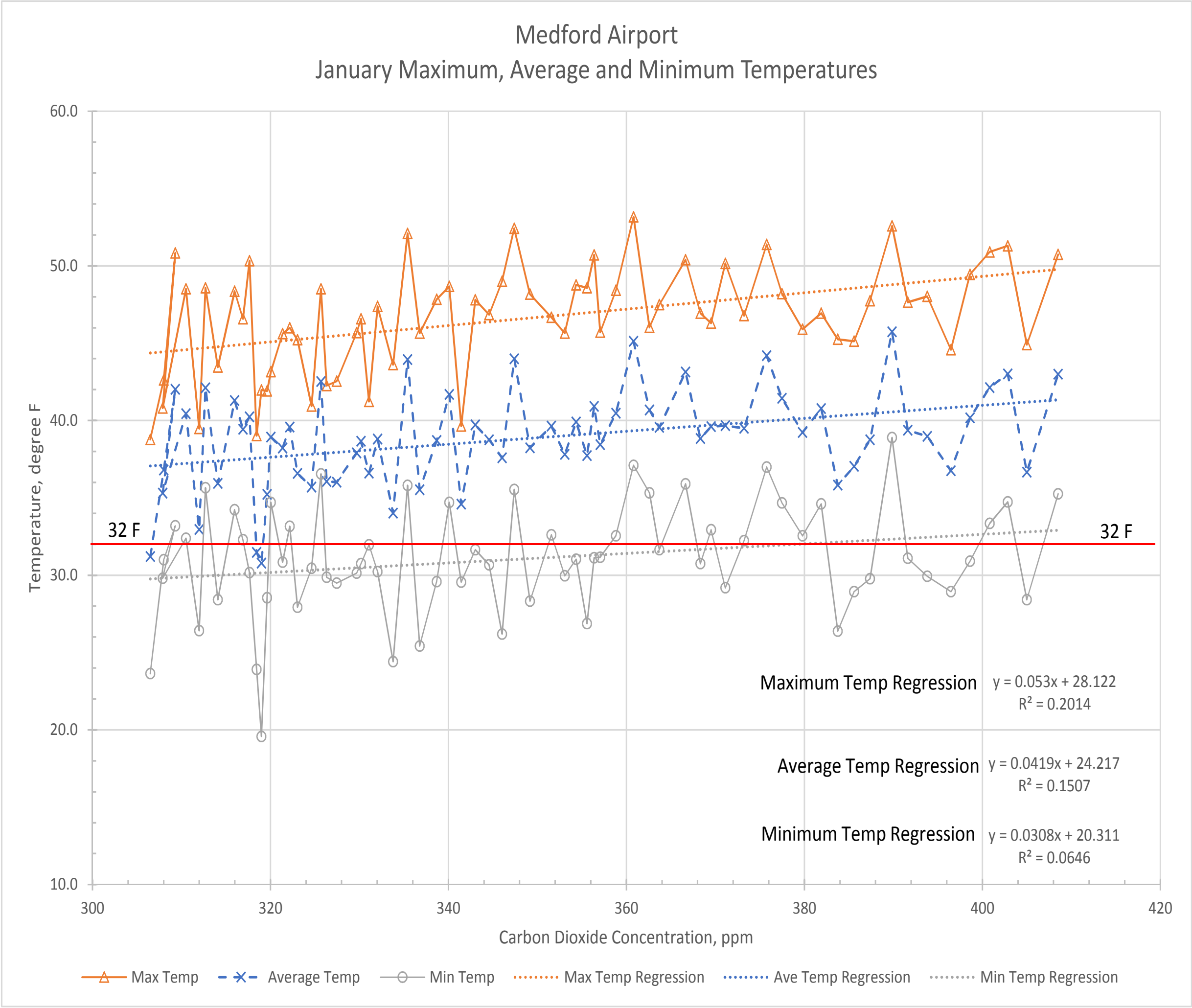
p-values less than 0.01 are considered statistically significant and they are highlighted in the above table.

Figure 2



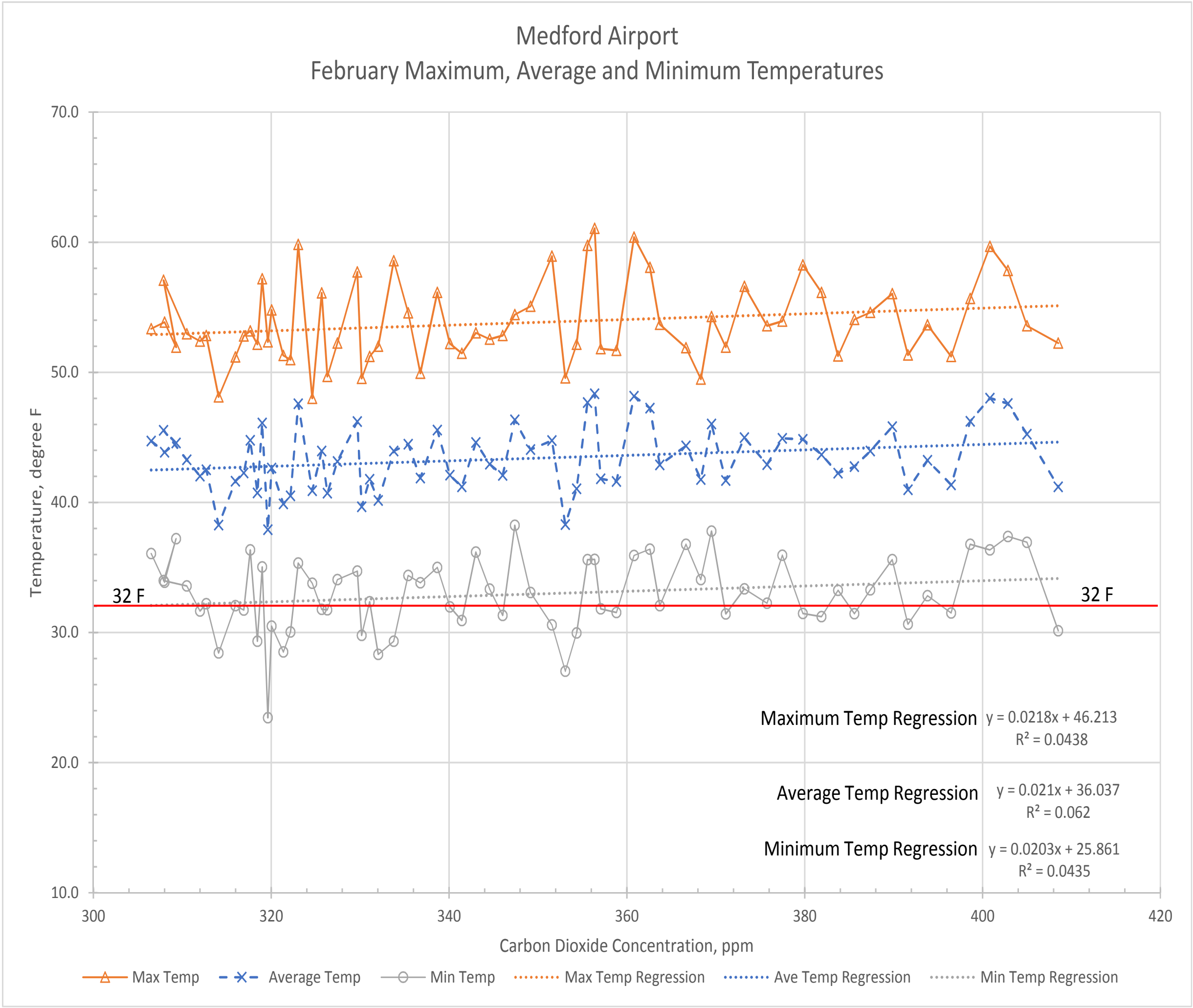
Medford Airport
Annual Average Maximum, Average and Minimum Temperatures
vs CO2 Concentration, ppm
Temperature, F
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
1965
1981
1995
2005
2015
Maximum Temp Regression
y = 0.0272x + 58.125
R² = 0.2515
Average Temp Regression
y = 0.0351x + 42.49
R² = 0.4678
Minimum Temp Regression
y = 0.0431x + 26.831
R² = 0.5495
Average Maximum
Average
Average Minimum
Year
Max Temp Regression
Average Temp Regression
Min Temp Regression

Figure 3



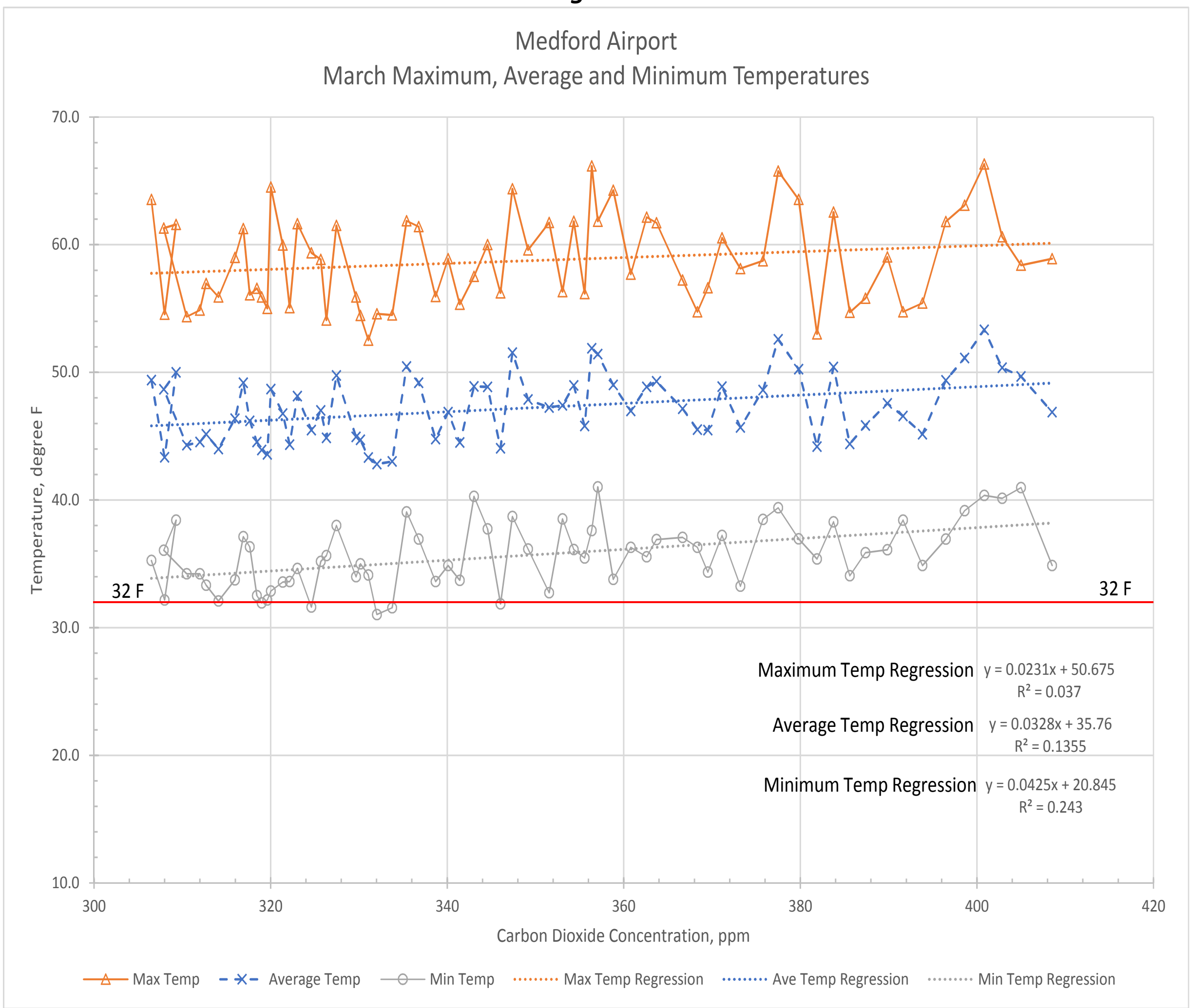
Medford Airport
January Maximum, Average and Minimum Temperatures
60.0
50.0
40.0
30.0
20.0
10.0
Temperature, degree F
32 F
32 F
Maximum Temp Regression
y = 0.053x + 28.122
R² = 0.2014
Average Temp Regression
y = 0.0419x + 24.217
R² = 0.1507
Minimum Temp Regression
y = 0.0308x + 20.311
R² = 0.0646
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 4



Medford Airport
February Maximum, Average and Minimum Temperatures
Temperature, degree F
70.0
60.0
50.0
40.0
30.0
20.0
10.0
32 F
32 F
Maximum Temp Regression y = 0.0218x + 46.213
R² = 0.0438
Average Temp Regression y = 0.021x + 36.037
R² = 0.062
Minimum Temp Regression y = 0.0203x + 25.861
R² = 0.0435
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 5



Medford Airport
March Maximum, Average and Minimum Temperatures
Temperature, degree F
70.0
60.0
50.0
40.0
30.0
20.0
10.0
32 F
32 F
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Maximum Temp Regression
y = 0.0231x + 50.675
R² = 0.037
Average Temp Regression
y = 0.0328x + 35.76
R² = 0.1355
Minimum Temp Regression
y = 0.0425x + 20.845
R² = 0.243
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 6

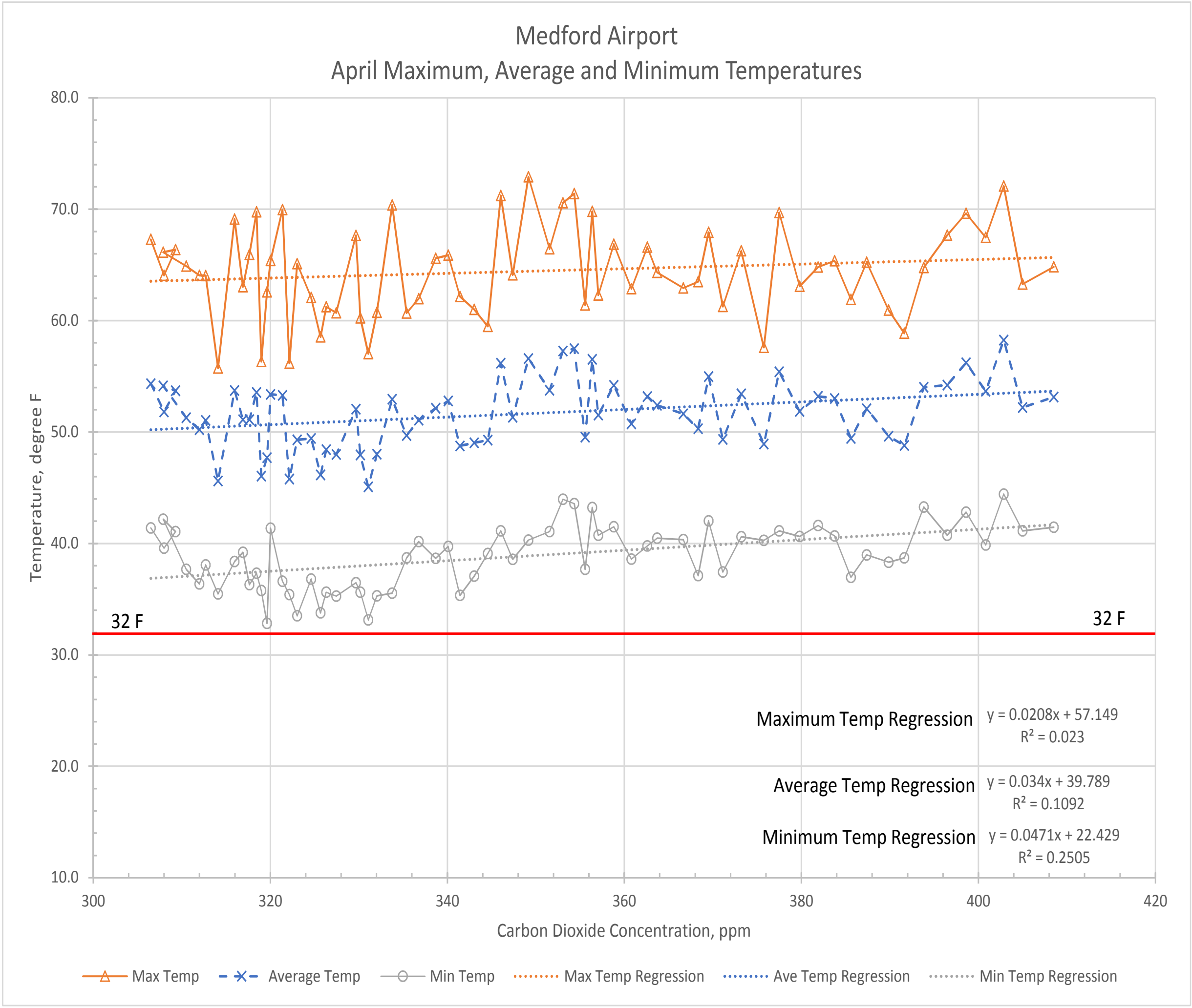
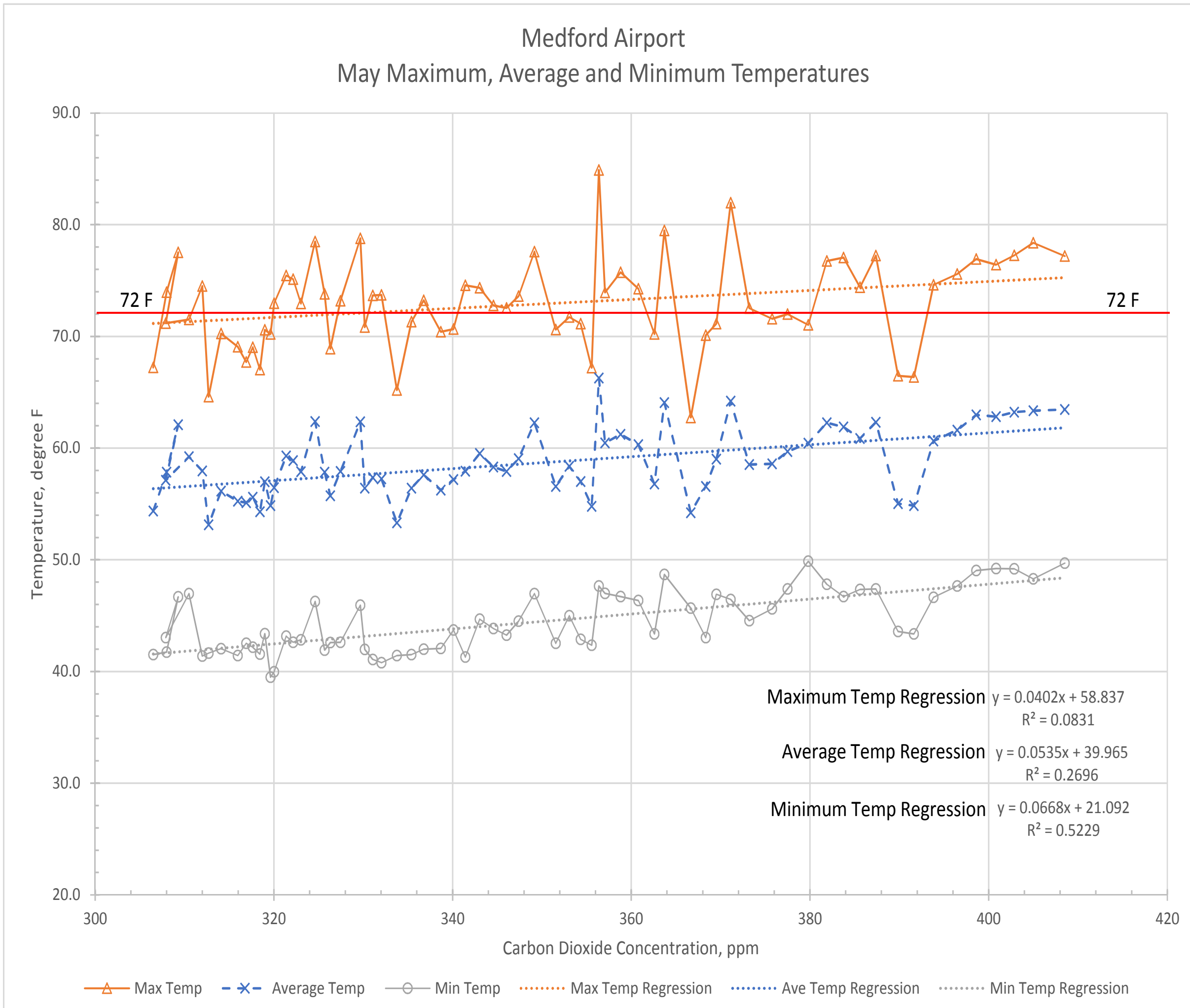
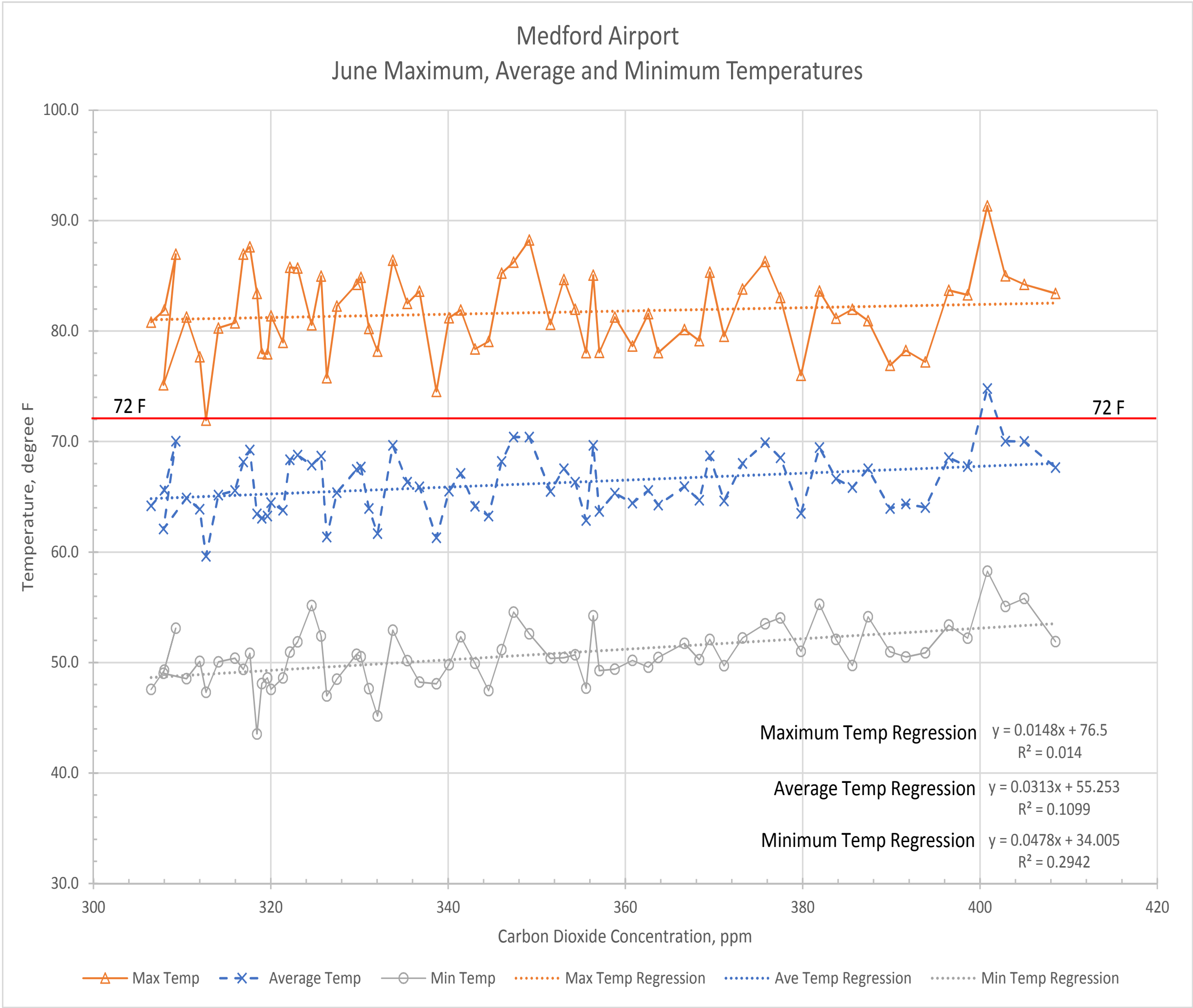

Medford Airport
April Maximum, Average and Minimum Temperatures
Temperature, degree F
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
32 F
32 F
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Maximum Temp Regression
y = 0.0208x + 57.149
R² = 0.023
Average Temp Regression
y = 0.034x + 39.789
R² = 0.1092
Minimum Temp Regression
y = 0.0471x + 22.429
R² = 0.2505
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 7



Medford Airport
May Maximum, Average and Minimum Temperatures
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Temperature, degree F
72 F
72 F
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Maximum Temp Regression
y = 0.0402x + 58.837
R² = 0.0831
Average Temp Regression
y = 0.0535x + 39.965
R² = 0.2696
Minimum Temp Regression
y = 0.0668x + 21.092
R² = 0.5229
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 8



Medford Airport
June Maximum, Average and Minimum Temperatures
100.0
90.0
80.0
72 F
72 F
70.0
60.0
50.0
40.0
30.0
Temperature, degree F
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Maximum Temp Regression
y = 0.0148x + 76.5
R² = 0.014
Average Temp Regression
y = 0.0313x + 55.253
R² = 0.1099
Minimum Temp Regression
y = 0.0478x + 34.005
R² = 0.2942
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 9

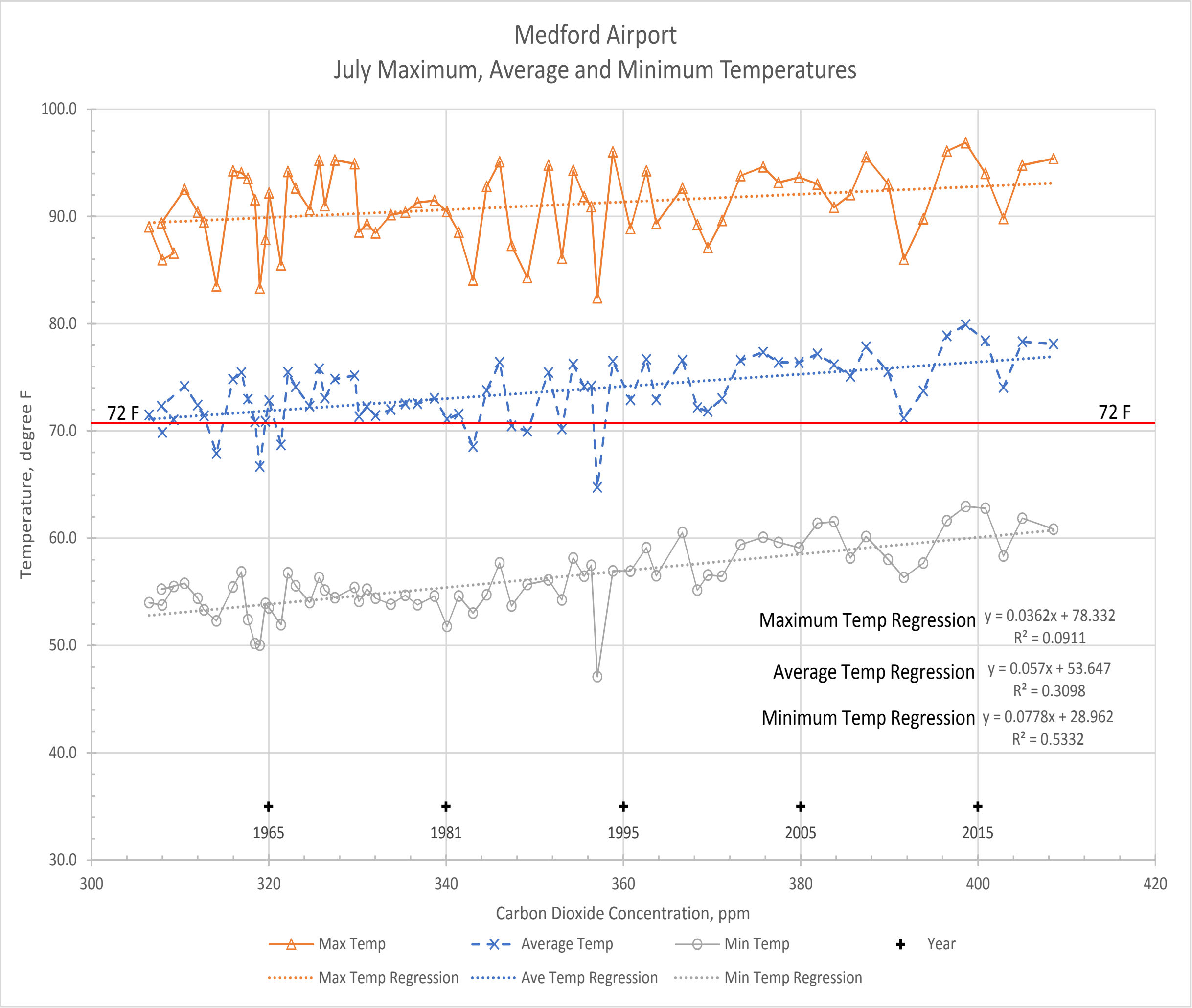
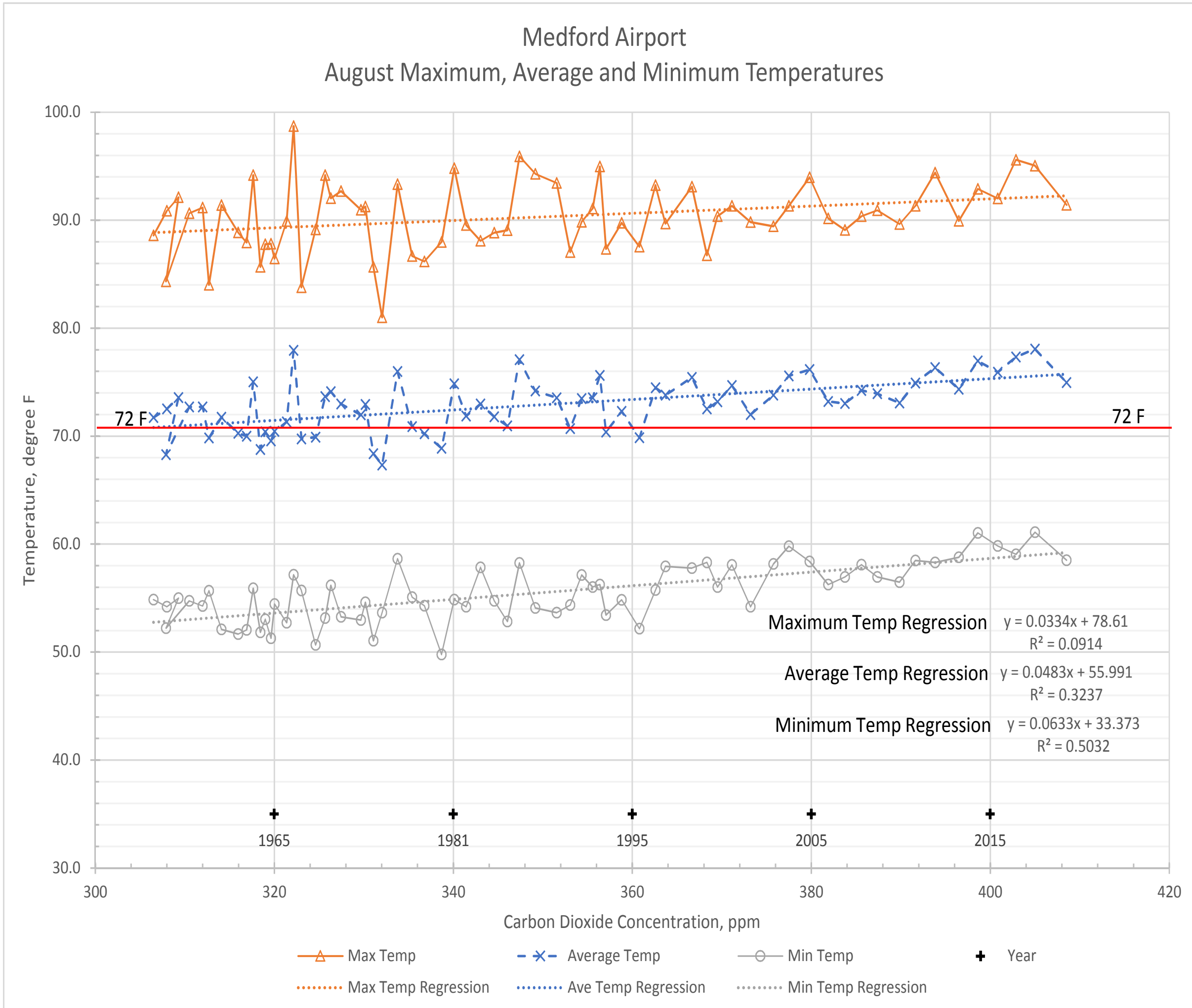
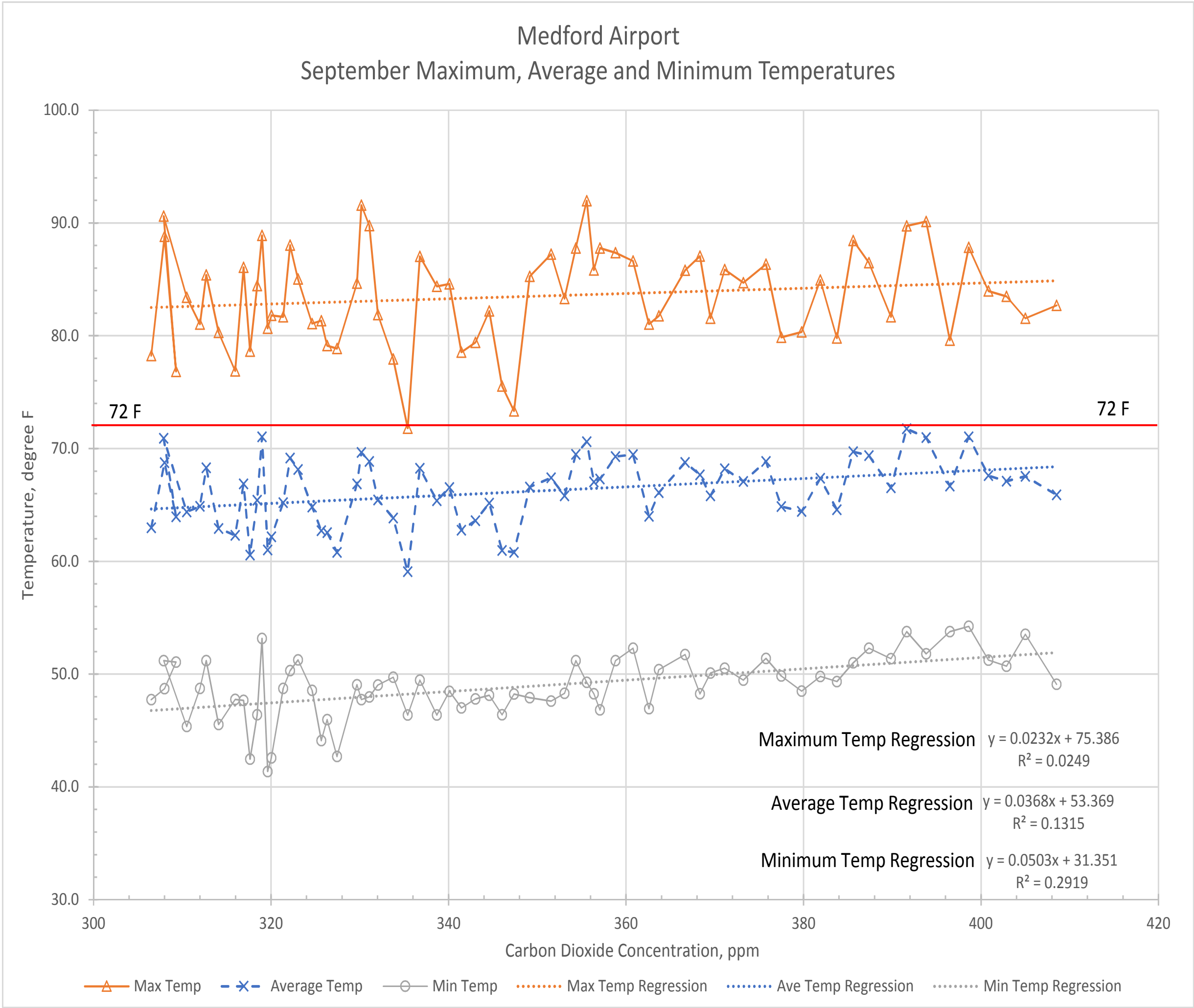

Medford Airport
July Maximum, Average and Minimum Temperatures
Temperature, degree F
Carbon Dioxide Concentration, ppm
72 F
72 F
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
300
320
340
360
380
400
420
1965
1981
1995
2005
2015
Maximum Temp Regression y = 0.0362x + 78.332
R² = 0.0911
Average Temp Regression y = 0.057x + 53.647
R² = 0.3098
Minimum Temp Regression y = 0.0778x + 28.962
R² = 0.5332
Max Temp
Average Temp
Min Temp
Year
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 10



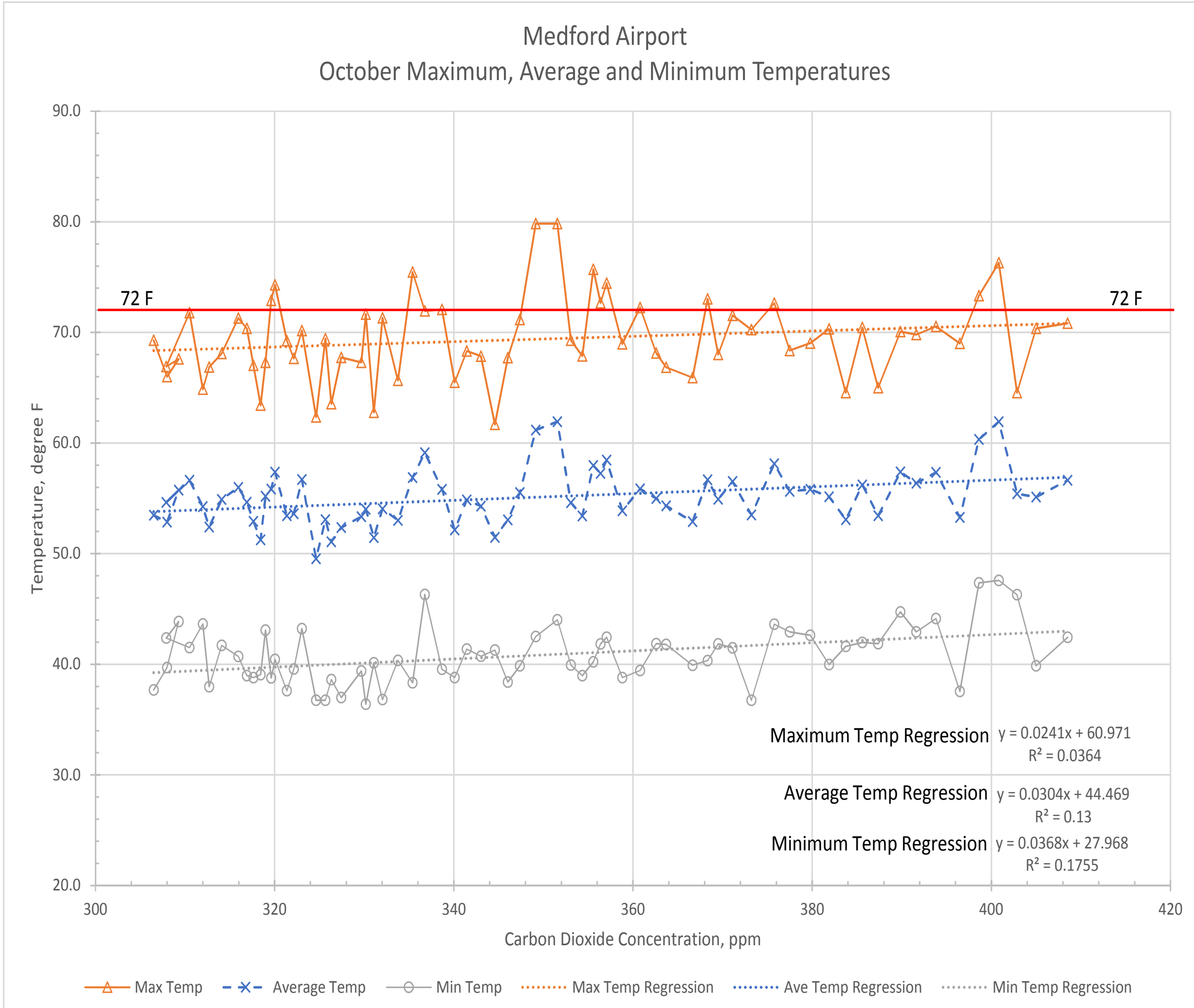
Medford Airport
August Maximum, Average and Minimum Temperatures
Temperature, degree F
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
72 F
72 F
Maximum Temp Regression y = 0.0334x + 78.61
R² = 0.0914
Average Temp Regression y = 0.0483x + 55.991
R² = 0.3237
Minimum Temp Regression y = 0.0633x + 33.373
R² = 0.5032
1965
1981
1995
2005
2015
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Max Temp
Average Temp
Min Temp
Year
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 11



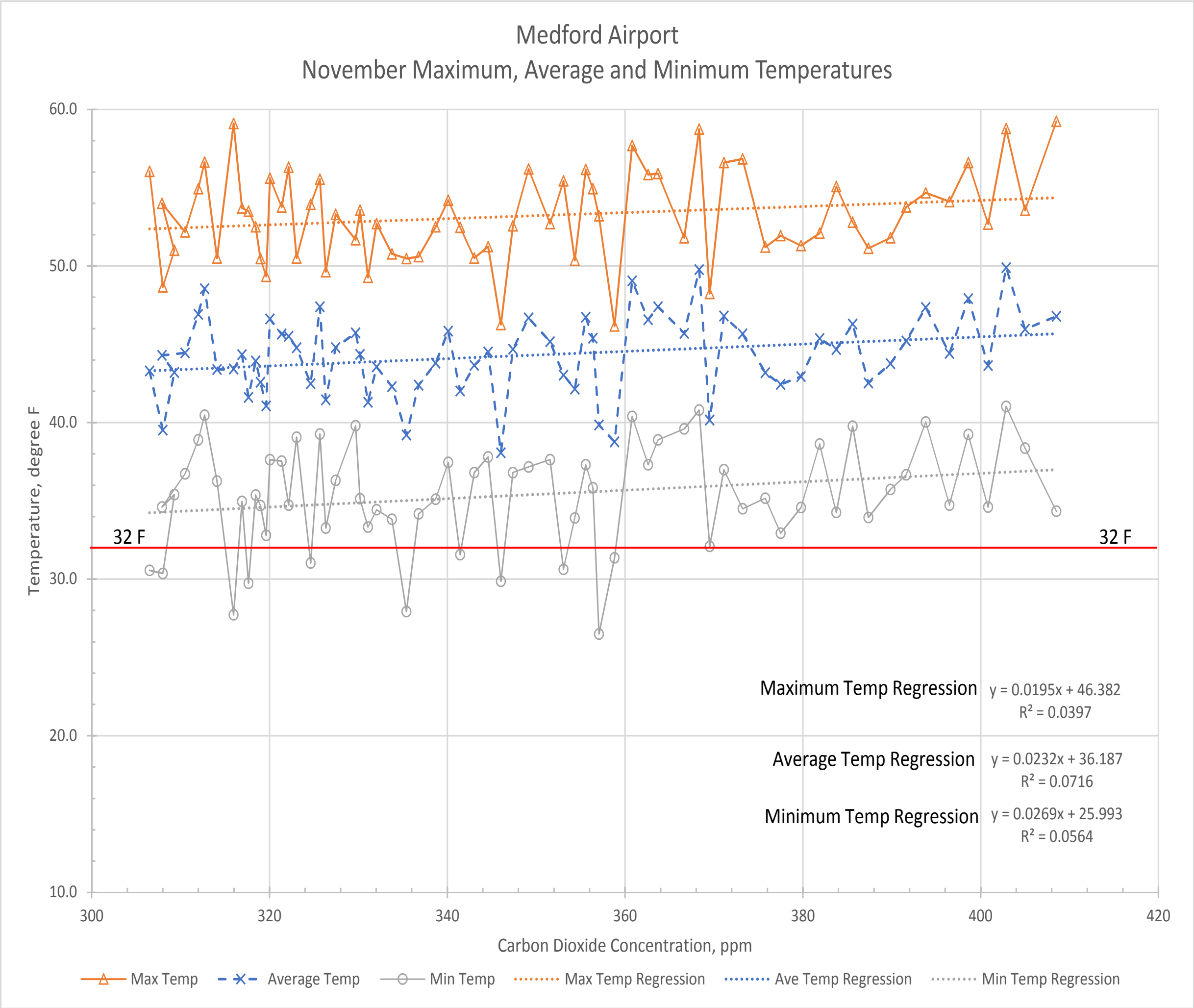
Medford Airport
September Maximum, Average and Minimum Temperatures
100.0
90.0
80.0
72 F
72 F
70.0
60.0
50.0
40.0
30.0
Temperature, degree F
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Maximum Temp Regression
y = 0.0232x + 75.386
R² = 0.0249
Average Temp Regression
y = 0.0368x + 53.369
R² = 0.1315
Minimum Temp Regression
y = 0.0503x + 31.351
R² = 0.2919
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 12



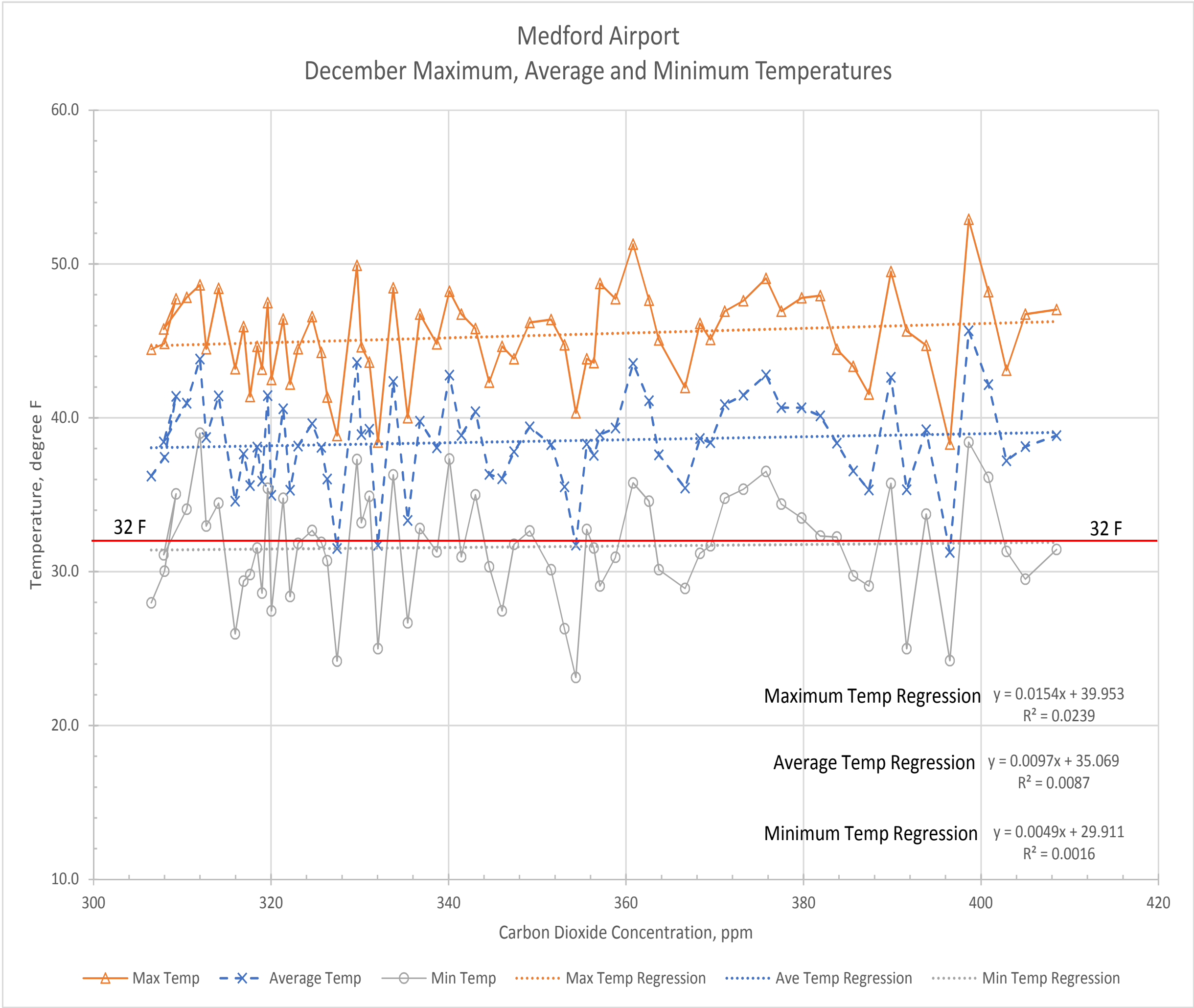
Medford Airport
October Maximum, Average and Minimum Temperatures
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Temperature, degree F
72 F
72 F
Maximum Temp Regression
y = 0.0241x + 60.971
R² = 0.0364
Average Temp Regression
y = 0.0304x + 44.469
R² = 0.13
Minimum Temp Regression
y = 0.0368x + 27.968
R² = 0.1755
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 13



Medford Airport
November Maximum, Average and Minimum Temperatures
60.0
50.0
40.0
30.0
20.0
10.0
Temperature, degree F
32 F
32 F
Maximum Temp Regression
y = 0.0195x + 46.382
R² = 0.0397
Average Temp Regression
y = 0.0232x + 36.187
R² = 0.0716
Minimum Temp Regression
y = 0.0269x + 25.993
R² = 0.0564
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 14



Medford Airport
December Maximum, Average and Minimum Temperatures
60.0
50.0
40.0
30.0
20.0
10.0
Temperature, degree F
32 F
32 F
Maximum Temp Regression
y = 0.0154x + 39.953
R² = 0.0239
Average Temp Regression
y = 0.0097x + 35.069
R² = 0.0087
Minimum Temp Regression
y = 0.0049x + 29.911
R² = 0.0016
300
320
340
360
380
400
420
Carbon Dioxide Concentration, ppm
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Table 2

Medford Airport Temperatures 1928-2018
Summary of Annual and Monthly Linear Regressions
Temperature vs Year

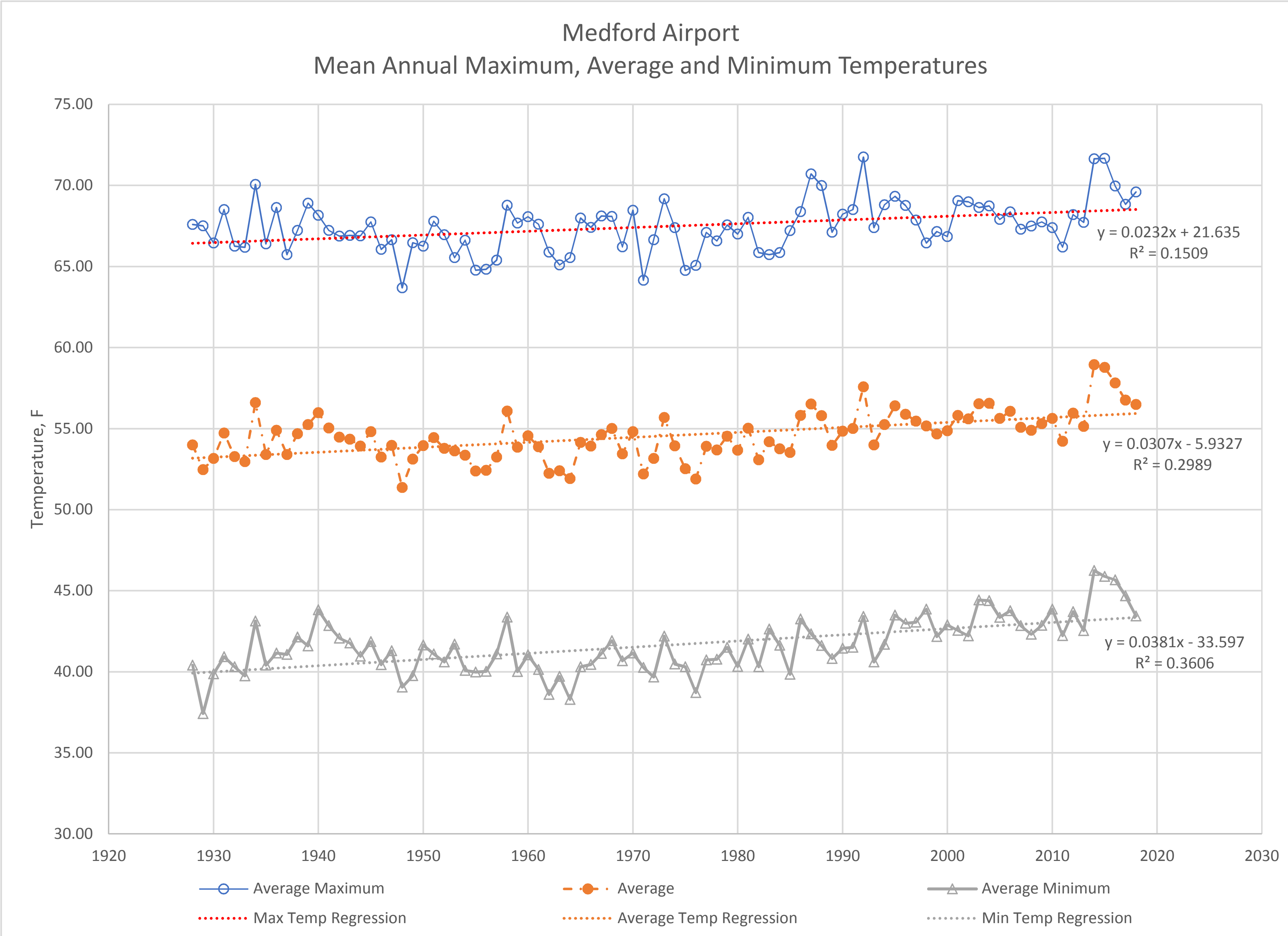
	Mean Maximum Temperature		
	Slope	**Intercept**	**R-SQ**
January	0.0588	-69.9136	0.1944
p-Value	**0.0000**	**0.0064**	
February	0.0330	-11.6924	0.0705
p-Value	*0.0109*	*0.6417*	
March	0.0116	35.8266	0.0070
p-Value	*0.4315*	*0.2183*	
April	-0.0074	79.5805	0.0021
p-Value	*0.6630*	*0.0200*	
May	0.0140	45.5826	0.0079
p-Value	*0.4033*	*0.1688*	
June	0.0409	0.2519	0.0814
p-Value	**0.0061**	*0.9930*	
July	0.0438	4.0826	0.1109
p-Value	**0.0013**	*0.8753*	
August	0.0372	16.4159	0.0840
p-Value	**0.0053**	*0.5244*	
September	0.0279	28.1876	0.0320
p-Value	*0.0900*	*0.3823*	
October	0.0162	37.3231	0.0119
p-Value	*0.3028*	*0.2304*	
November	-0.0036	60.5783	0.0011
p-Value	*0.7602*	*0.0111*	
December	0.0058	33.8821	0.0029
p-Value	*0.6139*	*0.1375*	
Annual	0.0232	21.6352	0.1509
p-Value	**0.0001**	0.0638	

	Average Temperature		
	Slope	**Intercept**	**R-SQ**
January	0.0479	-55.9735	0.1409
p-Value	**0.0002**	*0.0260*	
February	0.0294	-15.0179	0.0856
p-Value	**0.0049**	*0.4570*	
March	0.0215	4.6557	0.0447
p-Value	*0.0442*	*0.8233*	
April	0.0101	31.8991	0.0079
p-Value	*0.4031*	*0.1831*	
May	0.0276	4.4243	0.0605
p-Value	*0.0187*	*0.8461*	
June	0.0403	-13.8266	0.1500
p-Value	**0.0001**	*0.4926*	
July	0.0531	-31.6239	0.2333
p-Value	**0.0000**	*0.1199*	
August	0.0518	-29.9249	0.2702
p-Value	**0.0000**	*0.0965*	
September	0.0410	-15.0158	0.1363
p-Value	**0.0003**	*0.4881*	
October	0.0229	9.8708	0.0564
p-Value	*0.0234*	*0.6152*	
November	0.0199	4.8846	0.0432
p-Value	*0.0480*	*0.8035*	
December	0.0016	35.3388	0.0002
p-Value	*0.8905*	*0.1283*	
Annual	0.0307	-5.9327	0.2989
p-Value	**0.0000**	0.5473	

	Mean Minimum Temperature		
	Slope	**Intercept**	**R-SQ**
January	0.0369	-42.0334	0.0648
p-Value	*0.0149*	*0.1548*	
February	0.0258	-18.3435	0.0546
p-Value	*0.0259*	*0.4172*	
March	0.0314	-26.5151	0.1078
p-Value	**0.0015**	*0.1644*	
April	0.0277	-15.7824	0.0844
p-Value	**0.0052**	*0.4102*	
May	0.0412	-36.7339	0.1867
p-Value	**0.0000**	*0.0439*	
June	0.0397	-27.9051	0.1864
p-Value	**0.0000**	*0.1114*	
July	0.0624	-67.3303	0.3155
p-Value	**0.0000**	**0.0007**	
August	0.0665	-76.2658	0.4250
p-Value	**0.0000**	**0.0000**	
September	0.0541	-58.2192	0.2712
p-Value	**0.0000**	**0.0023**	
October	0.0295	-17.5816	0.0988
p-Value	**0.0024**	*0.3480*	
November	0.0434	-50.8090	0.0970
p-Value	**0.0027**	*0.0701*	
December	-0.0020	35.6642	0.0002
p-Value	*0.8821*	*0.1826*	
Annual	0.0381	-33.5967	0.3606
p-Value	**0.0000**	**0.0021**	

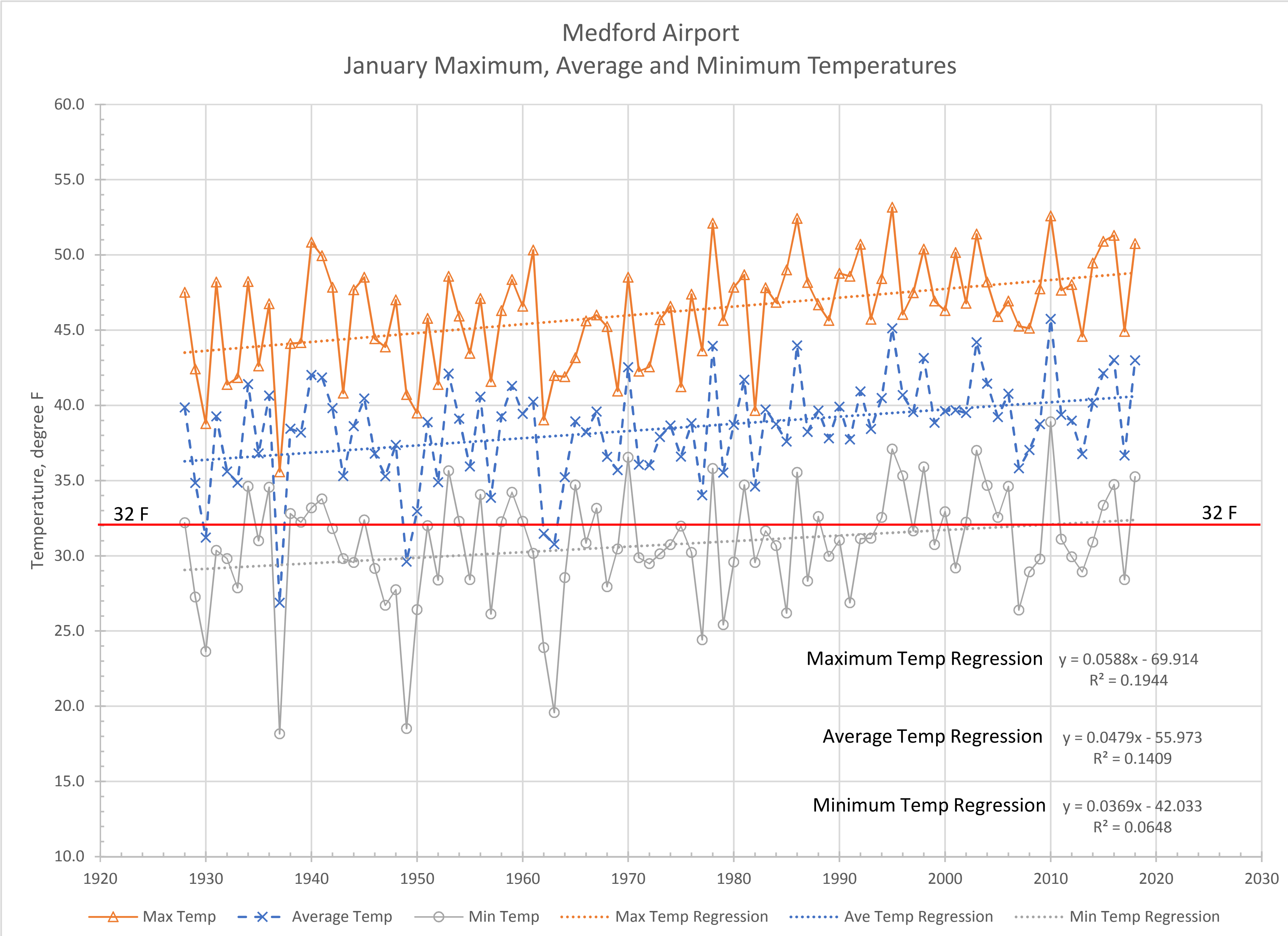
p-values less than 0.01 are considered statistically significant and are highlighted in the above table.

Figure 15



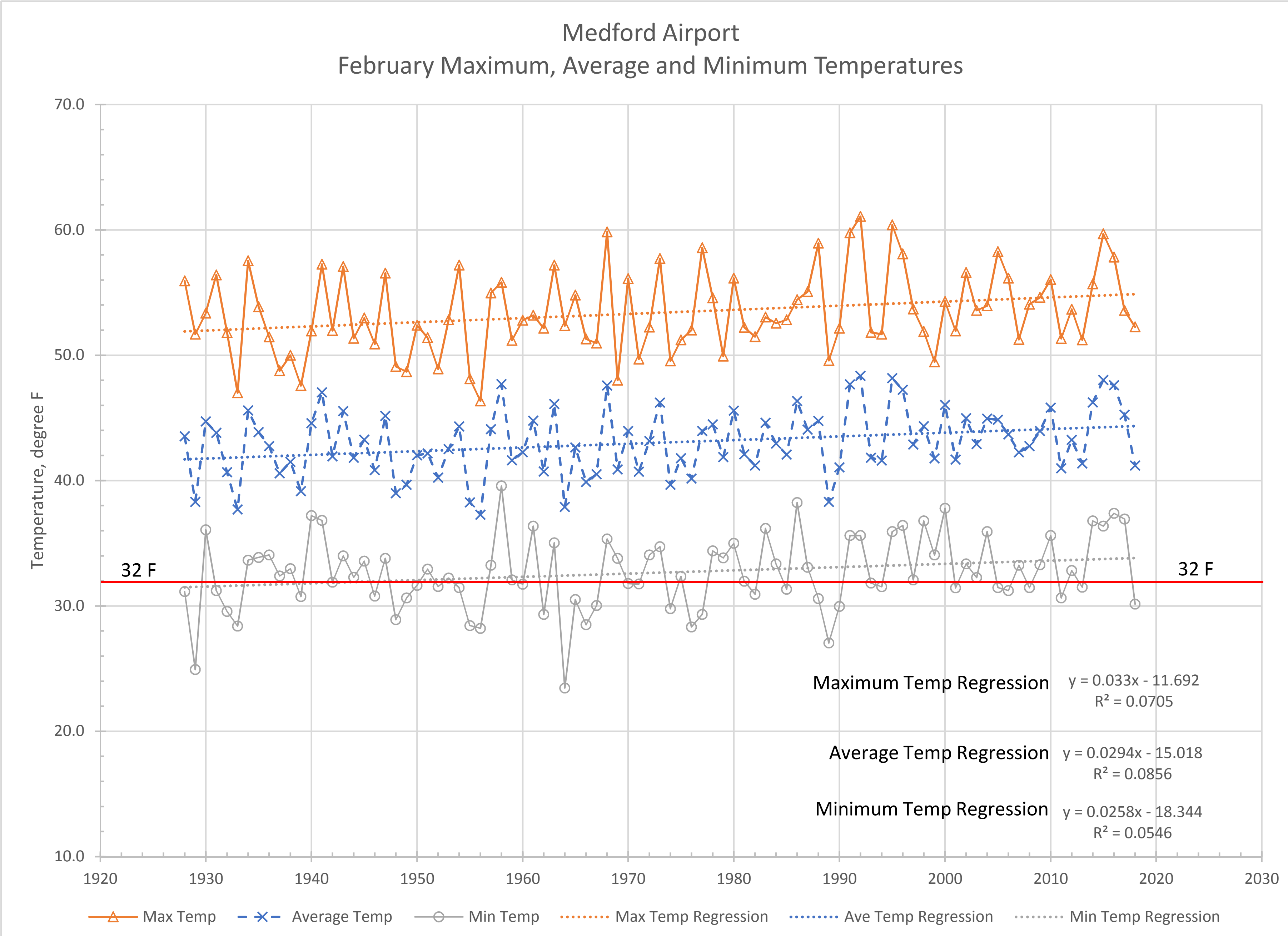
Statistical Analysis of the Medford Airport Temperature Data, 1928-2018

Figure 16



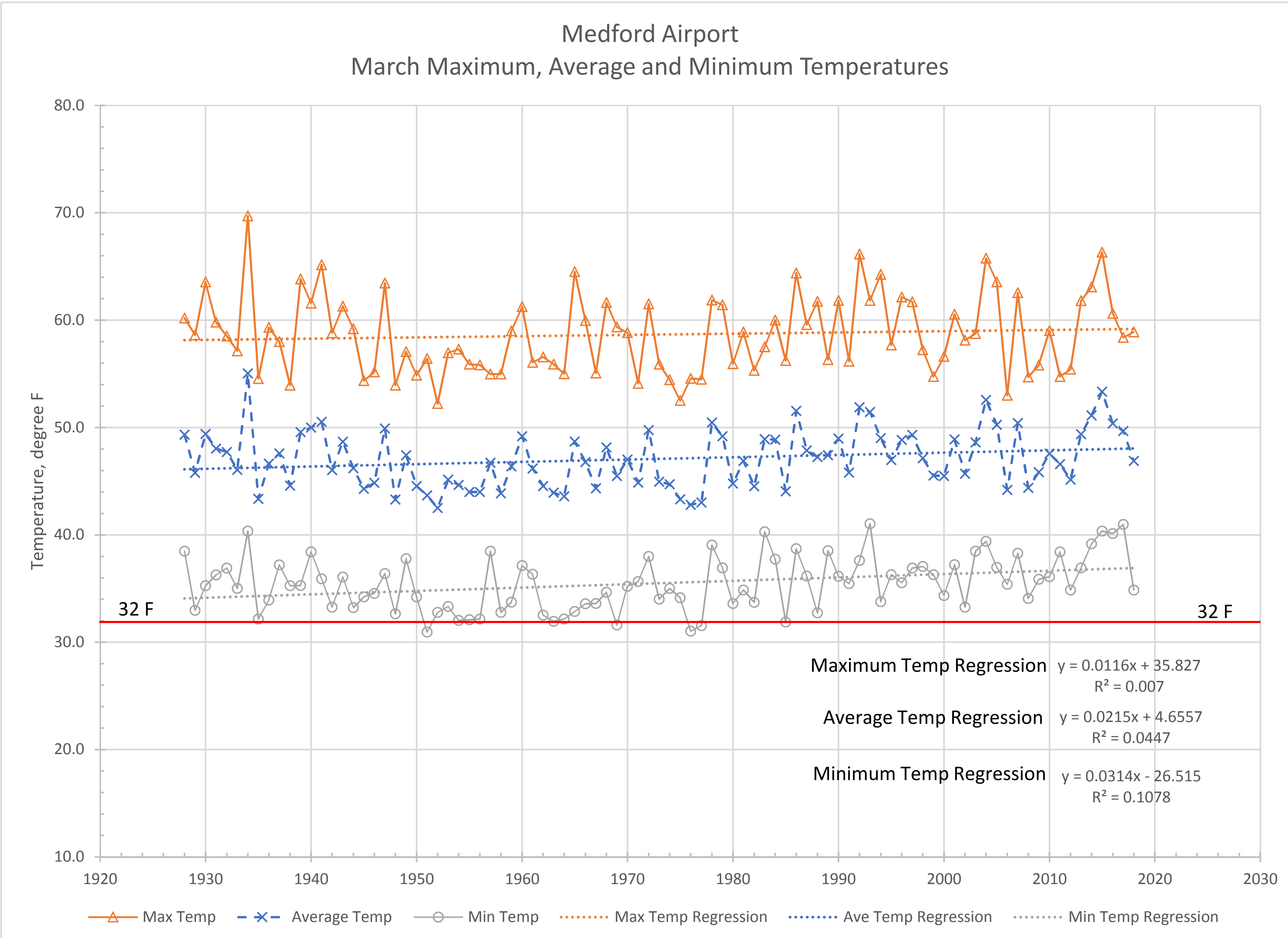
Medford Airport
January Maximum, Average and Minimum Temperatures
Temperature, degree F
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
32 F
32 F
Maximum Temp Regression
y = 0.0588x - 69.914
R² = 0.1944
Average Temp Regression
y = 0.0479x - 55.973
R² = 0.1409
Minimum Temp Regression
y = 0.0369x - 42.033
R² = 0.0648
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 17



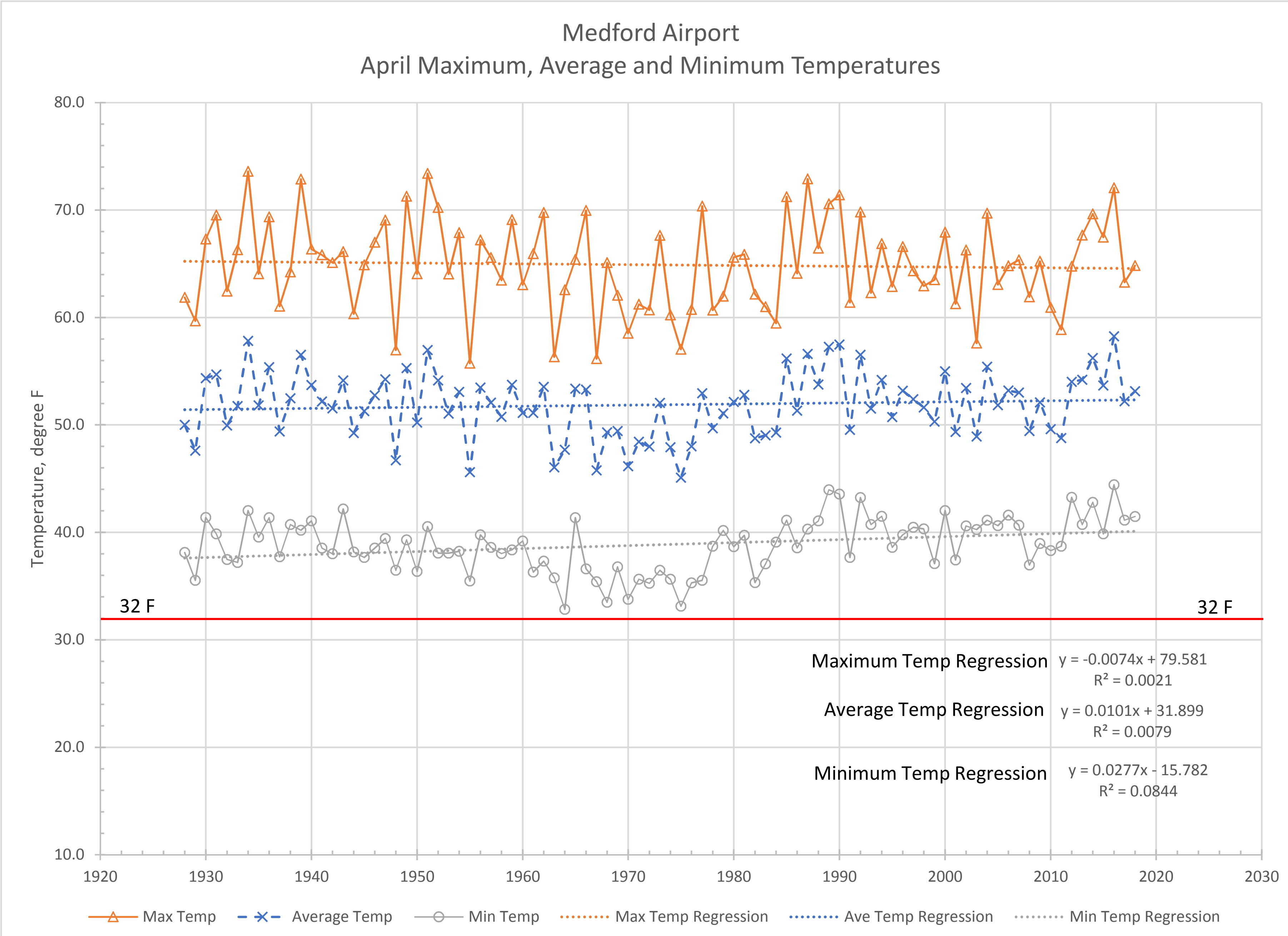
Statistical Analysis of the Medford Airport Temperature Data, 1928-2018

Figure 18



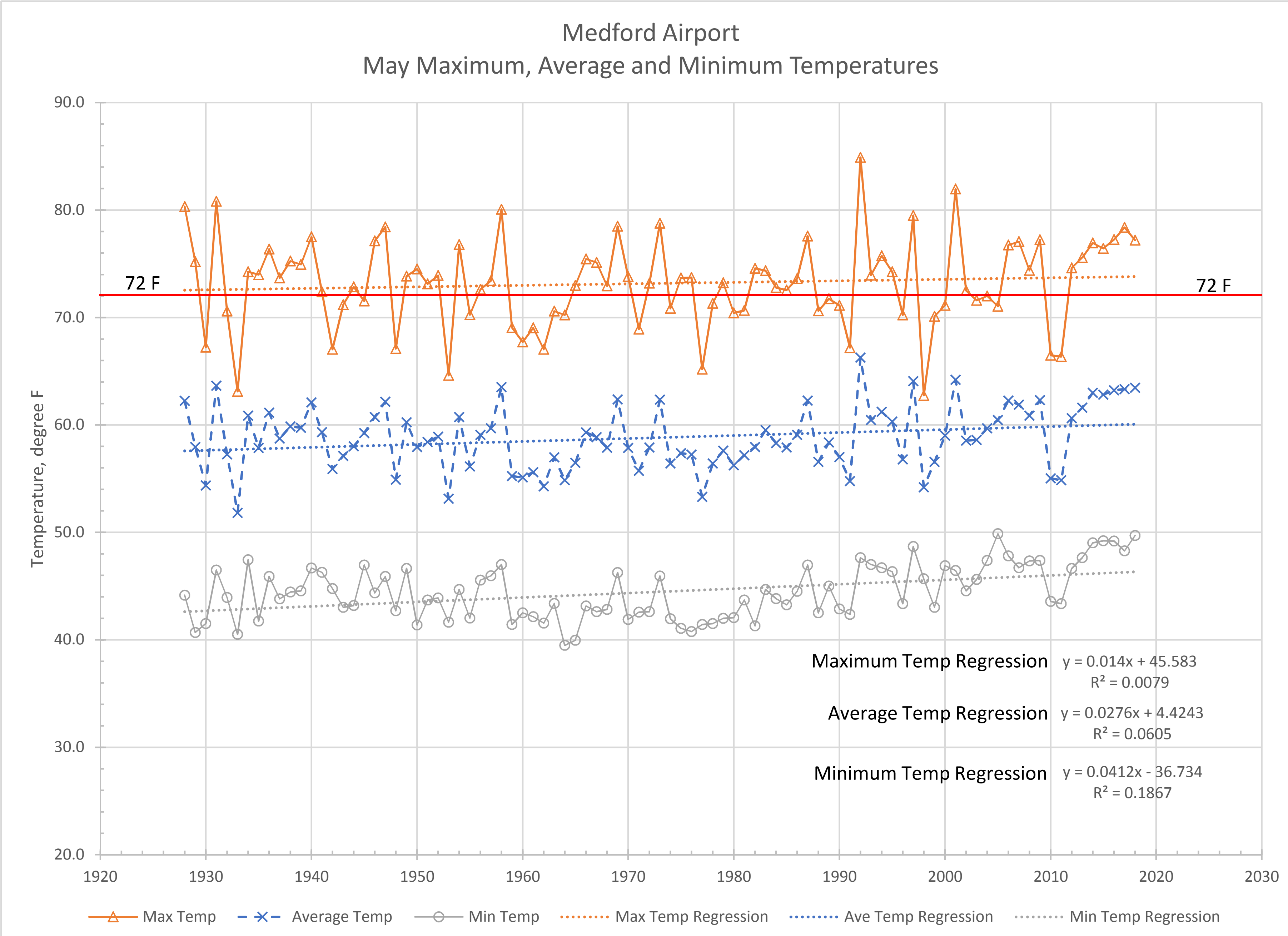
Medford Airport
March Maximum, Average and Minimum Temperatures
Temperature, degree F
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
32 F
32 F
Maximum Temp Regression
y = 0.0116x + 35.827
R² = 0.007
Average Temp Regression
y = 0.0215x + 4.6557
R² = 0.0447
Minimum Temp Regression
y = 0.0314x - 26.515
R² = 0.1078
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 19



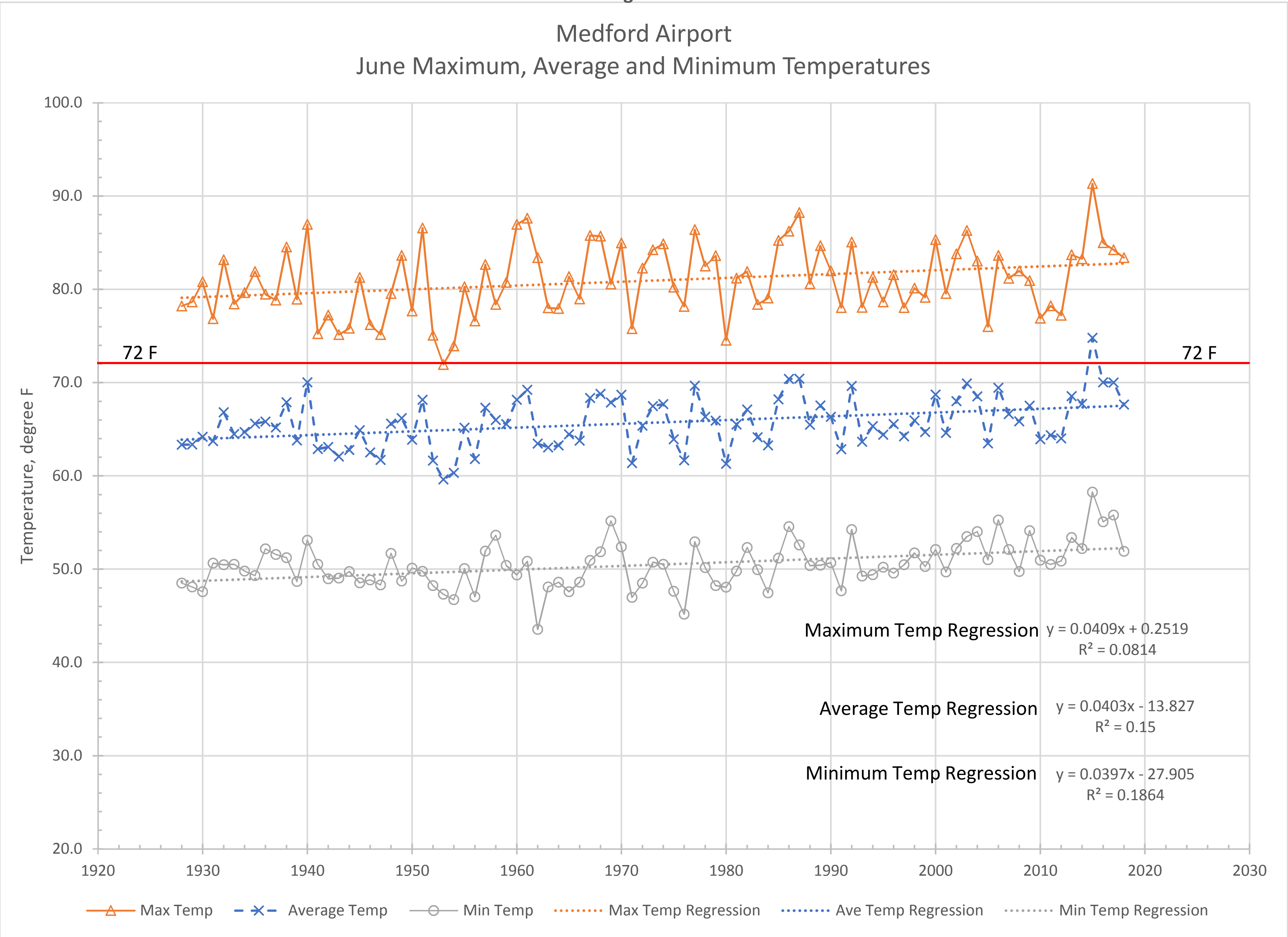
Statistical Analysis of the Medford Airport Temperature Data, 1928-2018

Figure 20



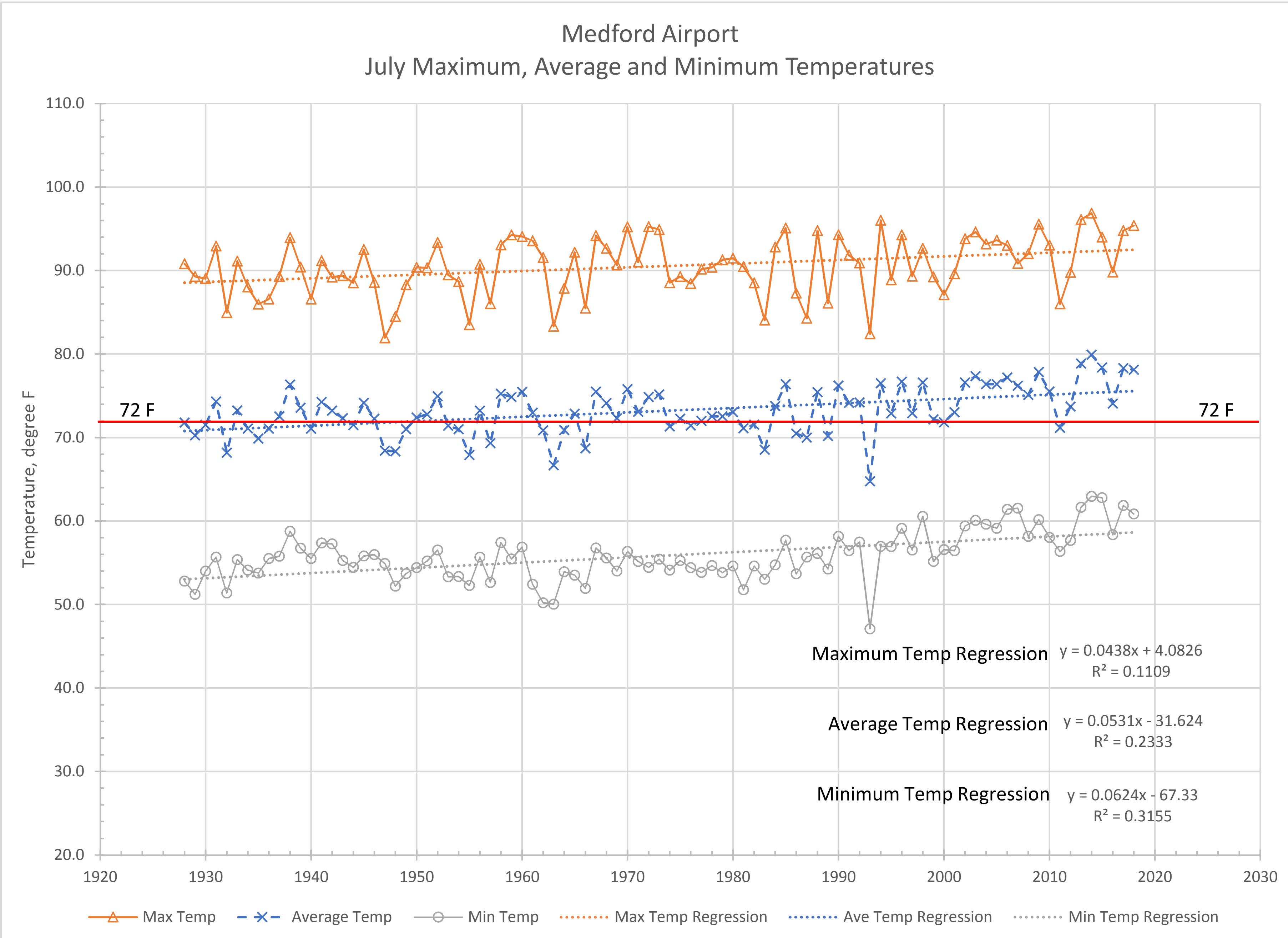
Medford Airport
May Maximum, Average and Minimum Temperatures
Temperature, degree F
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
72 F
72 F
Maximum Temp Regression y = 0.014x + 45.583
R² = 0.0079
Average Temp Regression y = 0.0276x + 4.4243
R² = 0.0605
Minimum Temp Regression y = 0.0412x - 36.734
R² = 0.1867
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 21



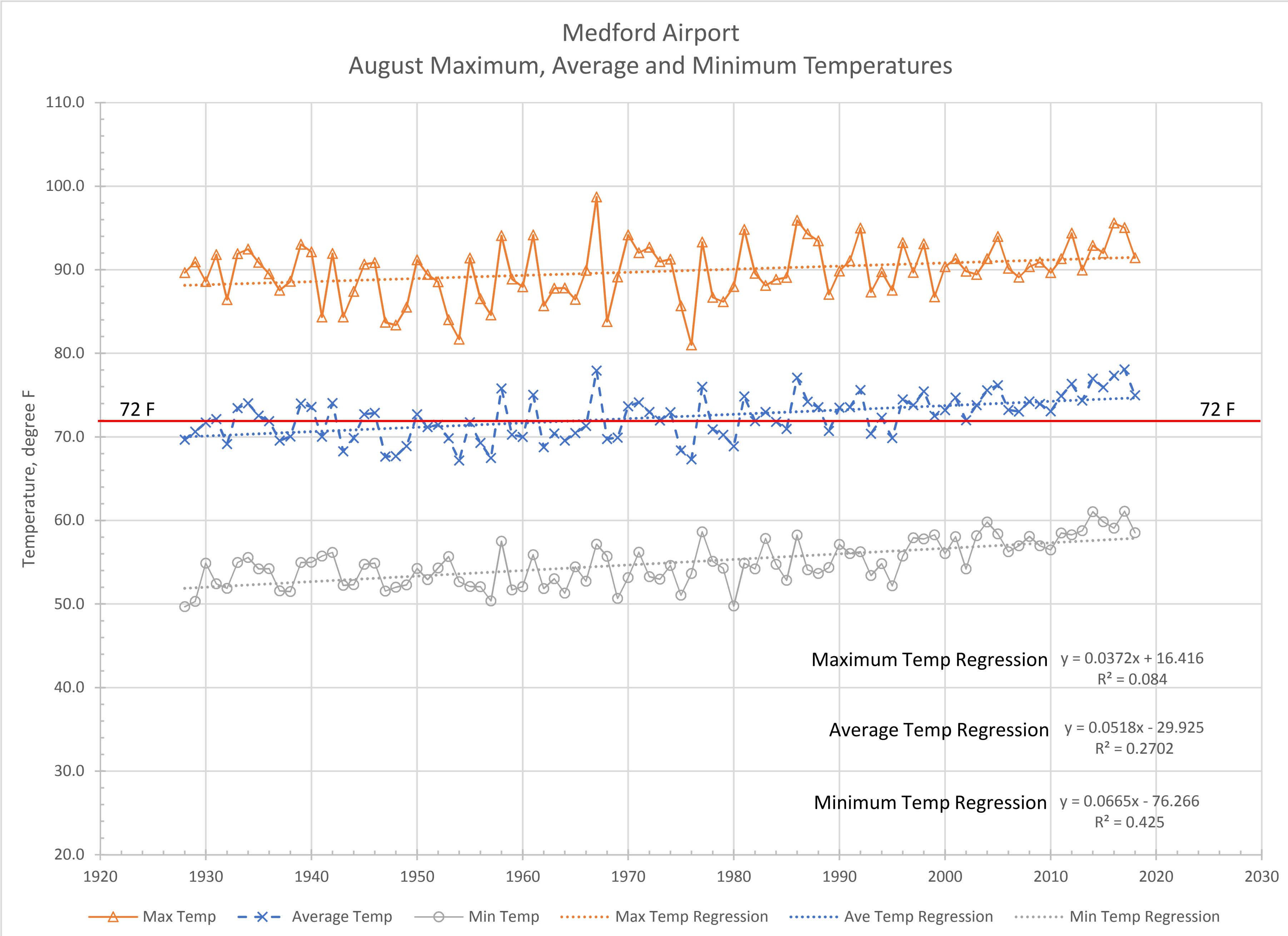
Medford Airport
June Maximum, Average and Minimum Temperatures
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Temperature, degree F
72 F
72 F
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Maximum Temp Regression
y = 0.0409x + 0.2519
R² = 0.0814
Average Temp Regression
y = 0.0403x - 13.827
R² = 0.15
Minimum Temp Regression
y = 0.0397x - 27.905
R² = 0.1864
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 22



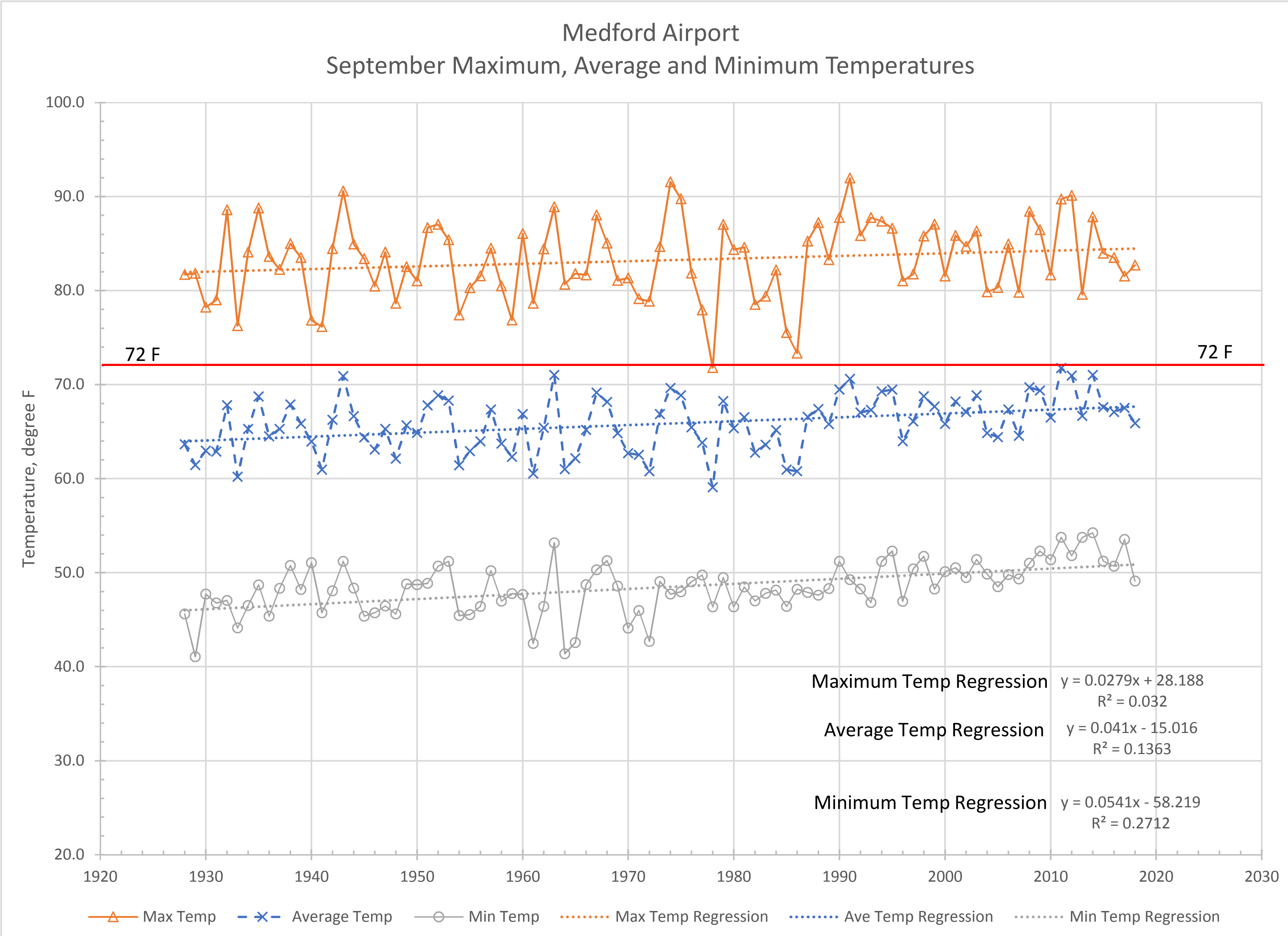
Statistical Analysis of the Medford Airport Temperature Data, 1928-2018

Figure 23



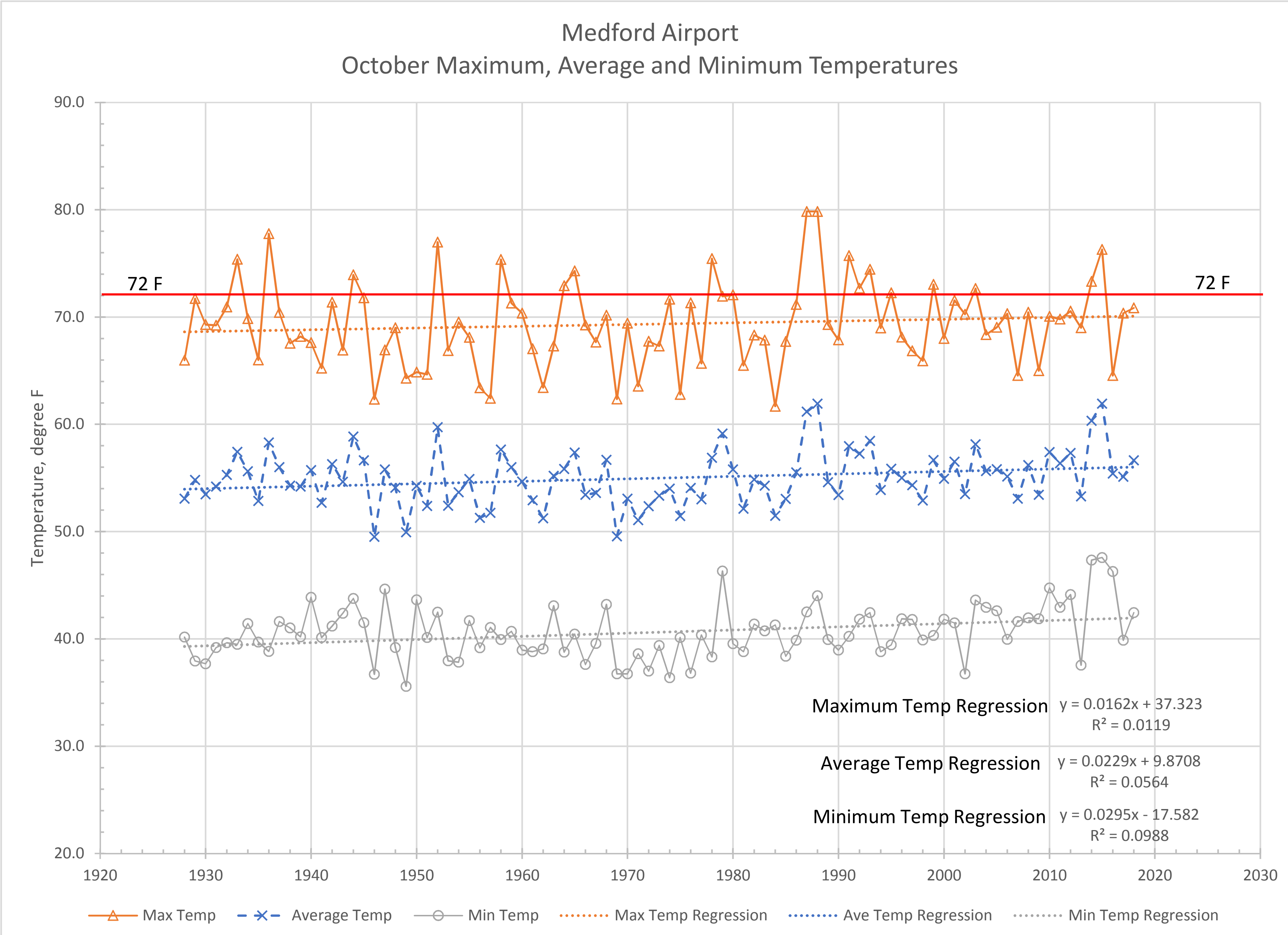
Statistical Analysis of the Medford Airport Temperature Data, 1928-2018

Figure 24



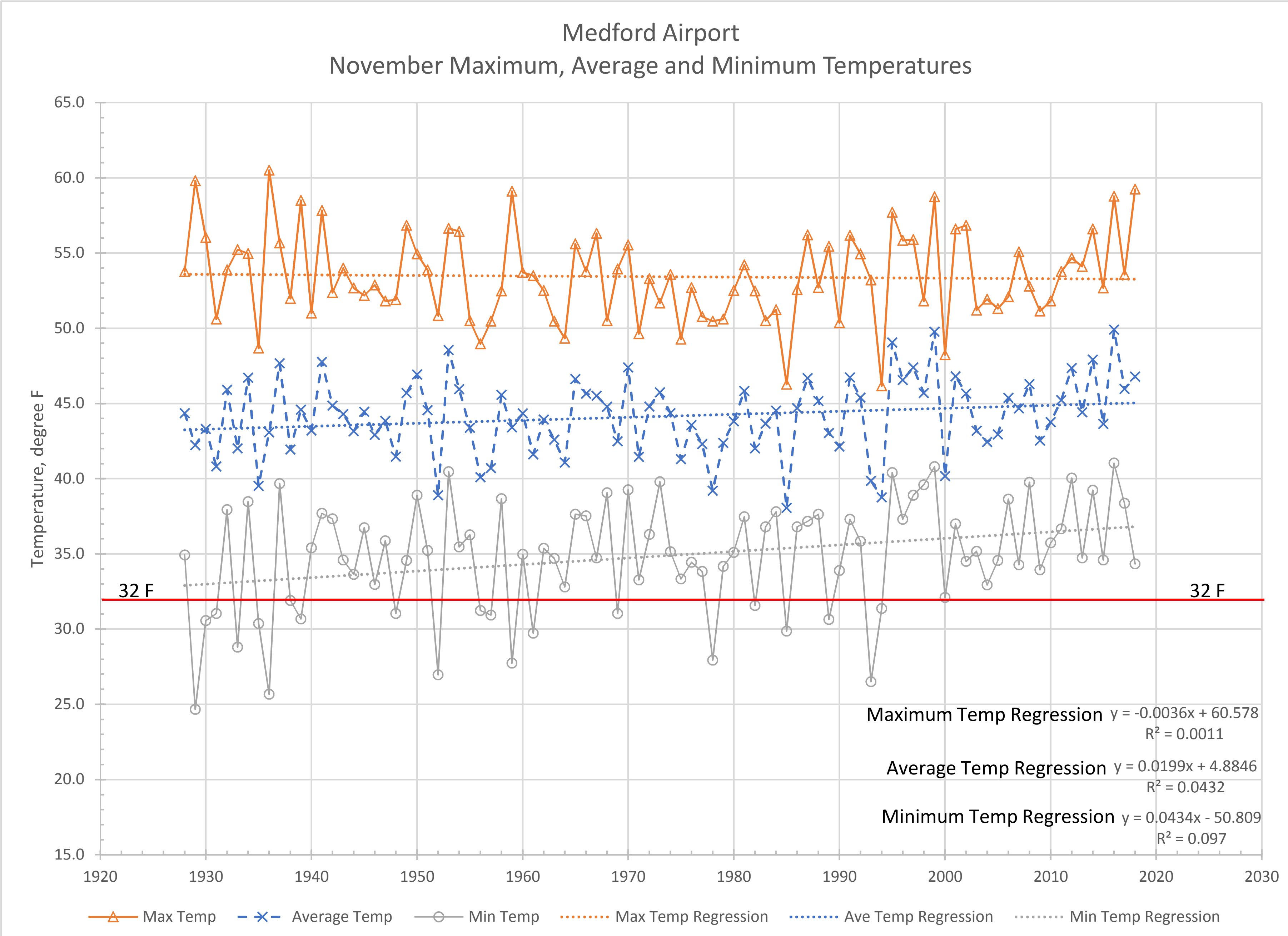
Medford Airport
September Maximum, Average and Minimum Temperatures
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Temperature, degree F
72 F
72 F
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Maximum Temp Regression
y = 0.0279x + 28.188
R² = 0.032
Average Temp Regression
y = 0.041x - 15.016
R² = 0.1363
Minimum Temp Regression
y = 0.0541x - 58.219
R² = 0.2712
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 25



Medford Airport
October Maximum, Average and Minimum Temperatures
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Temperature, degree F
72 F
72 F
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Maximum Temp Regression
y = 0.0162x + 37.323
R² = 0.0119
Average Temp Regression
y = 0.0229x + 9.8708
R² = 0.0564
Minimum Temp Regression
y = 0.0295x - 17.582
R² = 0.0988
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 26



Medford Airport
November Maximum, Average and Minimum Temperatures
Temperature, degree F
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
32 F
32 F
Maximum Temp Regression y = -0.0036x + 60.578
R² = 0.0011
Average Temp Regression y = 0.0199x + 4.8846
R² = 0.0432
Minimum Temp Regression y = 0.0434x - 50.809
R² = 0.097
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

Figure 27

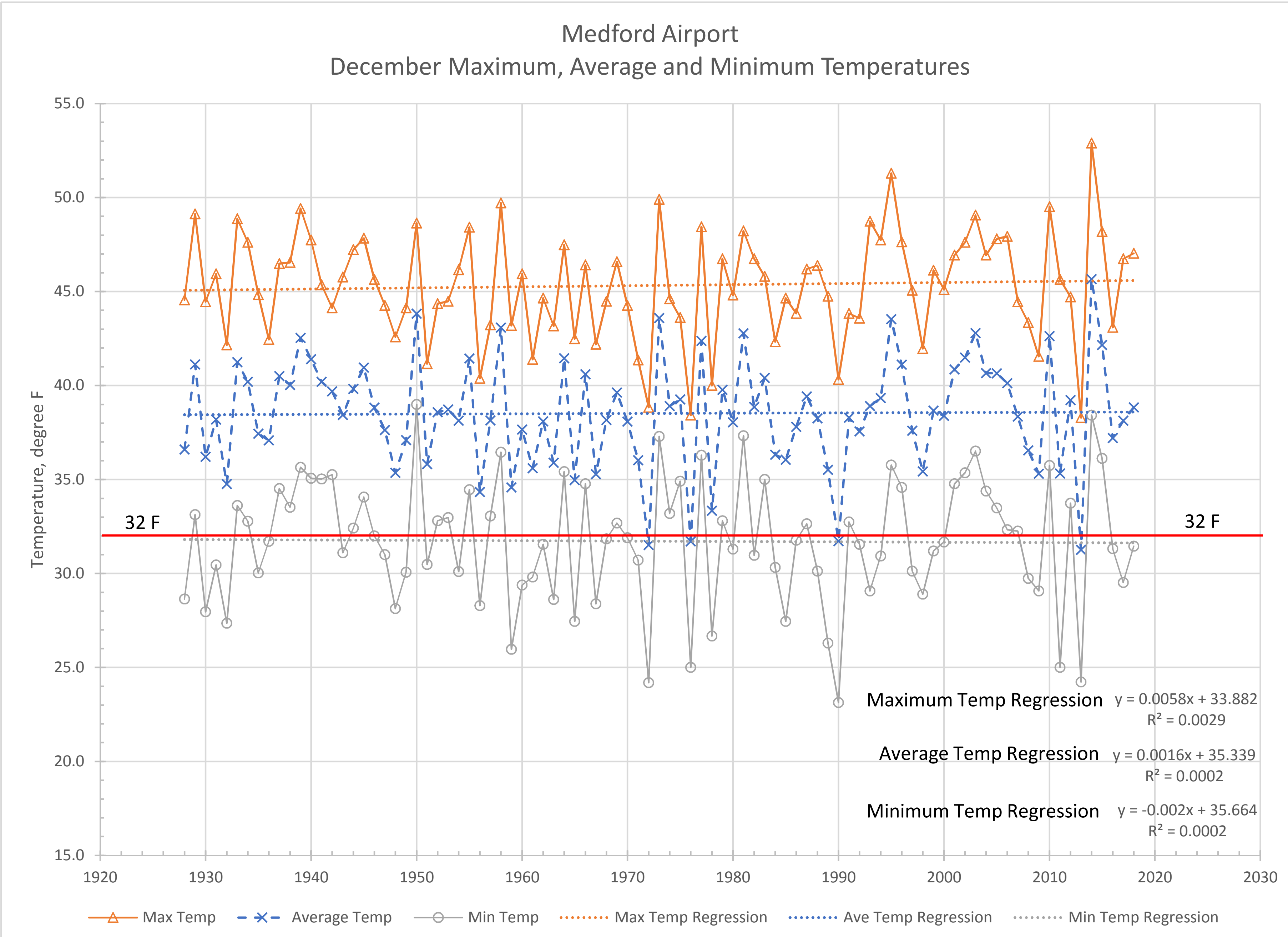

Medford Airport
December Maximum, Average and Minimum Temperatures
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
Temperature, degree F
32 F
32 F
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Maximum Temp Regression y = 0.0058x + 33.882
R² = 0.0029
Average Temp Regression y = 0.0016x + 35.339
R² = 0.0002
Minimum Temp Regression y = -0.002x + 35.664
R² = 0.0002
Max Temp
Average Temp
Min Temp
Max Temp Regression
Ave Temp Regression
Min Temp Regression

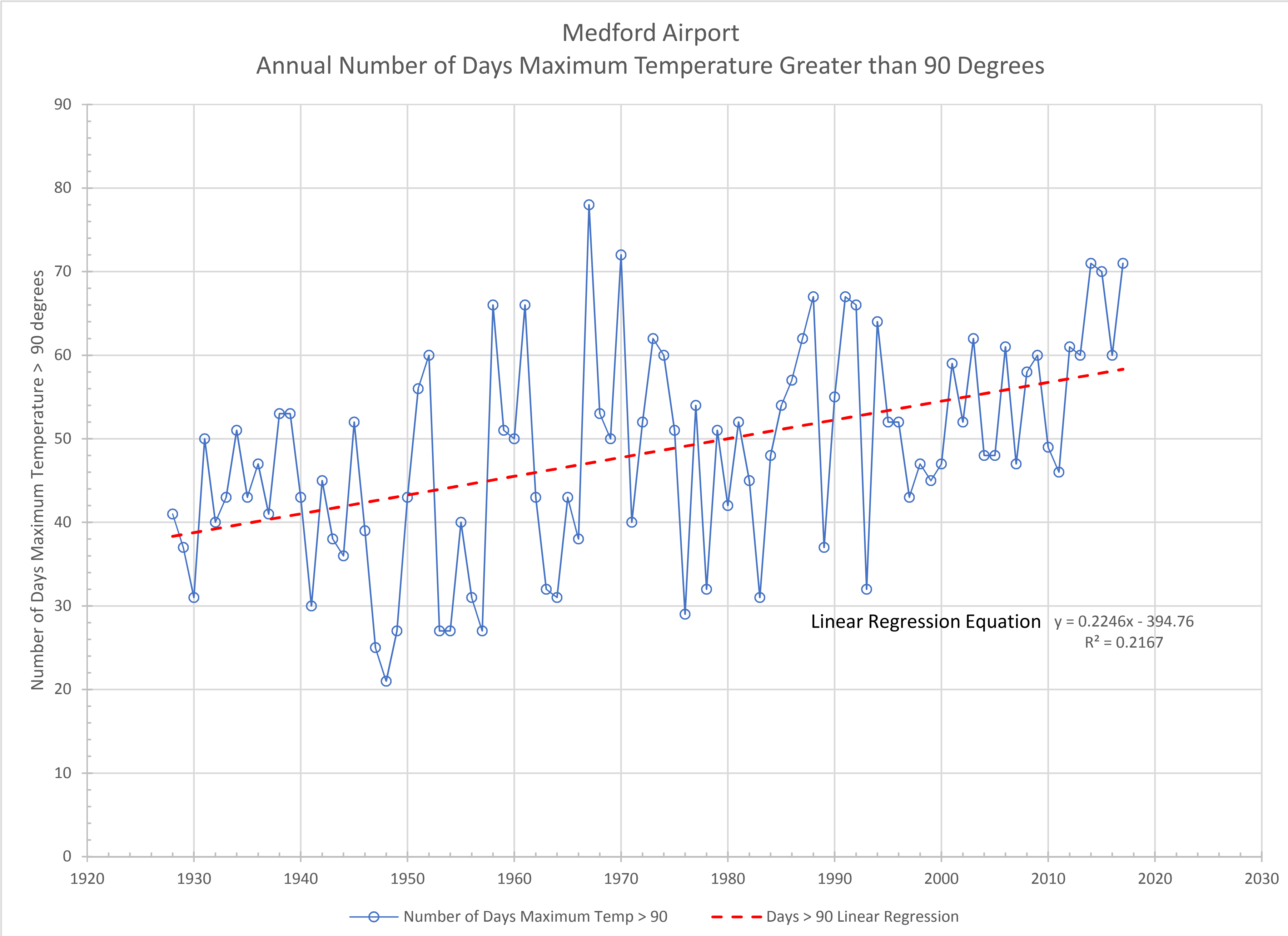
Table 3

Medford Airport Temperatures 1928-2018
Summary of Annual and Monthly Linear Regressions
Number of Days vs Year

	Number of Days Temp > 90 Degrees		
	Slope	**Intercept**	**R-SQ**
Annual	0.2221	-389.786988	0.2183
p-Value	**0.0000**	**0.0000**	
July	0.0842	-149.8685	0.1452
p-Value	**0.0002**	**0.0007**	
August	0.0678	-118.0045	0.0962
p-Value	**0.0028**	**0.0080**	

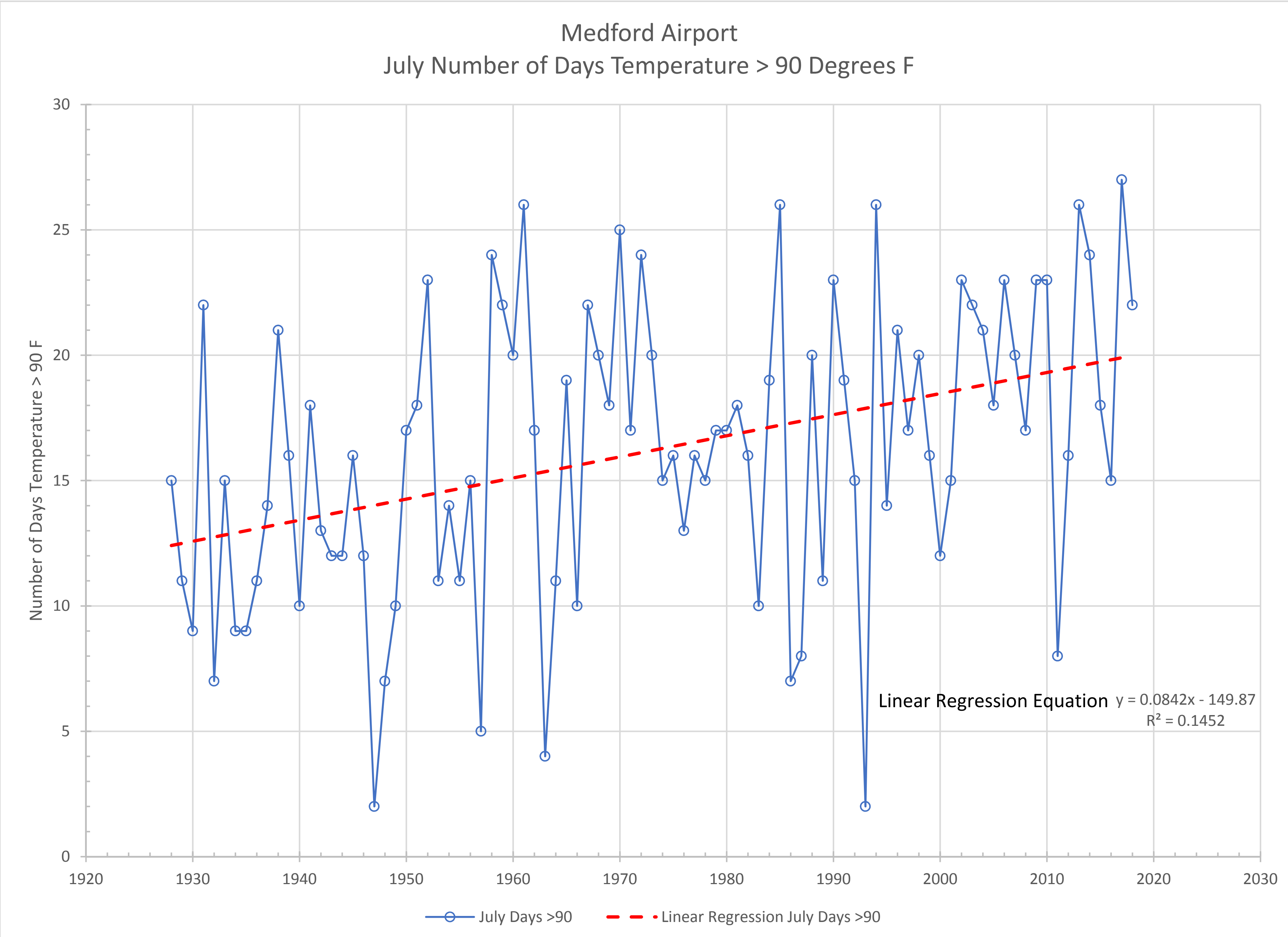
	Number of Days Temp < 32 Degrees		
	Slope	**Intercept**	**R-SQ**
Annual	-0.2713	601.278739	0.1406
p-Value	**0.0002**	**0.0000**	
November	-0.0785	164.5644	0.1001
p-Value	**0.0023**	**0.0012**	

Figure 28



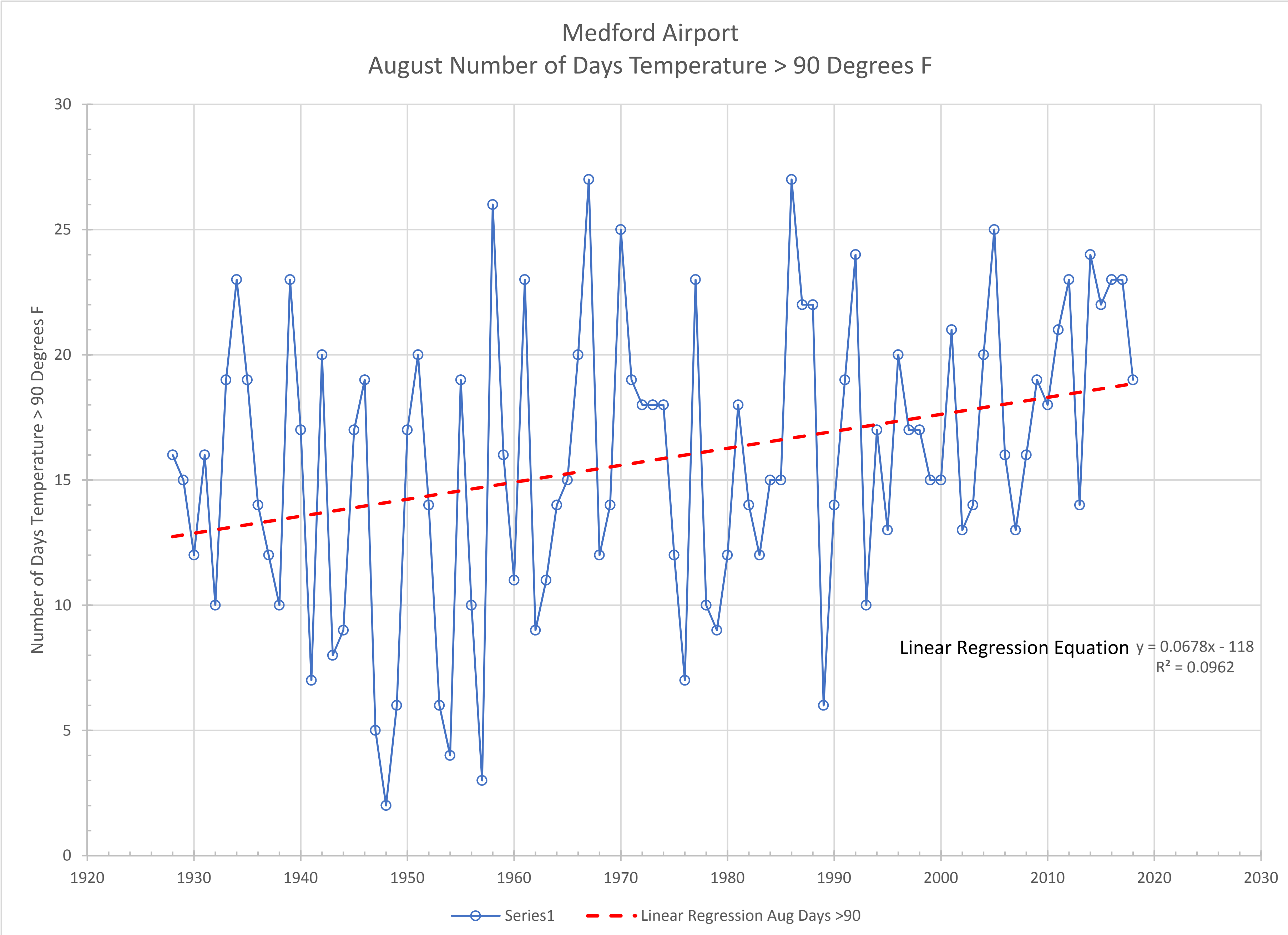
Medford Airport
Annual Number of Days Maximum Temperature Greater than 90 Degrees
Number of Days Maximum Temperature > 90 degrees
90
80
70
60
50
40
30
20
10
0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Linear Regression Equation
y = 0.2246x - 394.76
R² = 0.2167
Number of Days Maximum Temp > 90
Days > 90 Linear Regression

Figure 29



Medford Airport
July Number of Days Temperature > 90 Degrees F
Number of Days Temperature > 90 F
30
25
20
15
10
5
0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Linear Regression Equation
y = 0.0842x - 149.87
R² = 0.1452
July Days >90
Linear Regression July Days >90

Figure 30



Statistical Analysis of the Medford Airport Temperature Data, 1928-2018

Figure 31

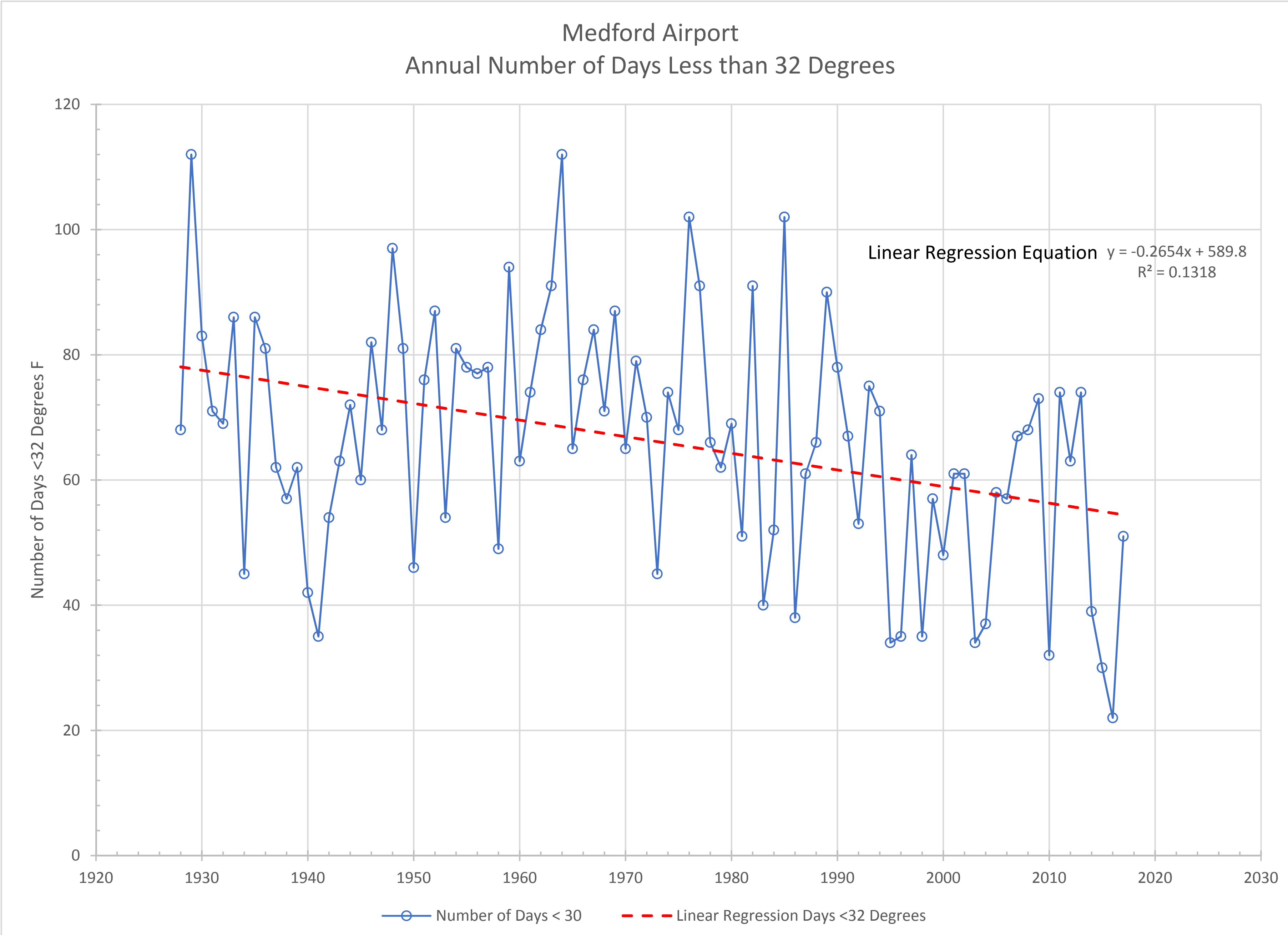
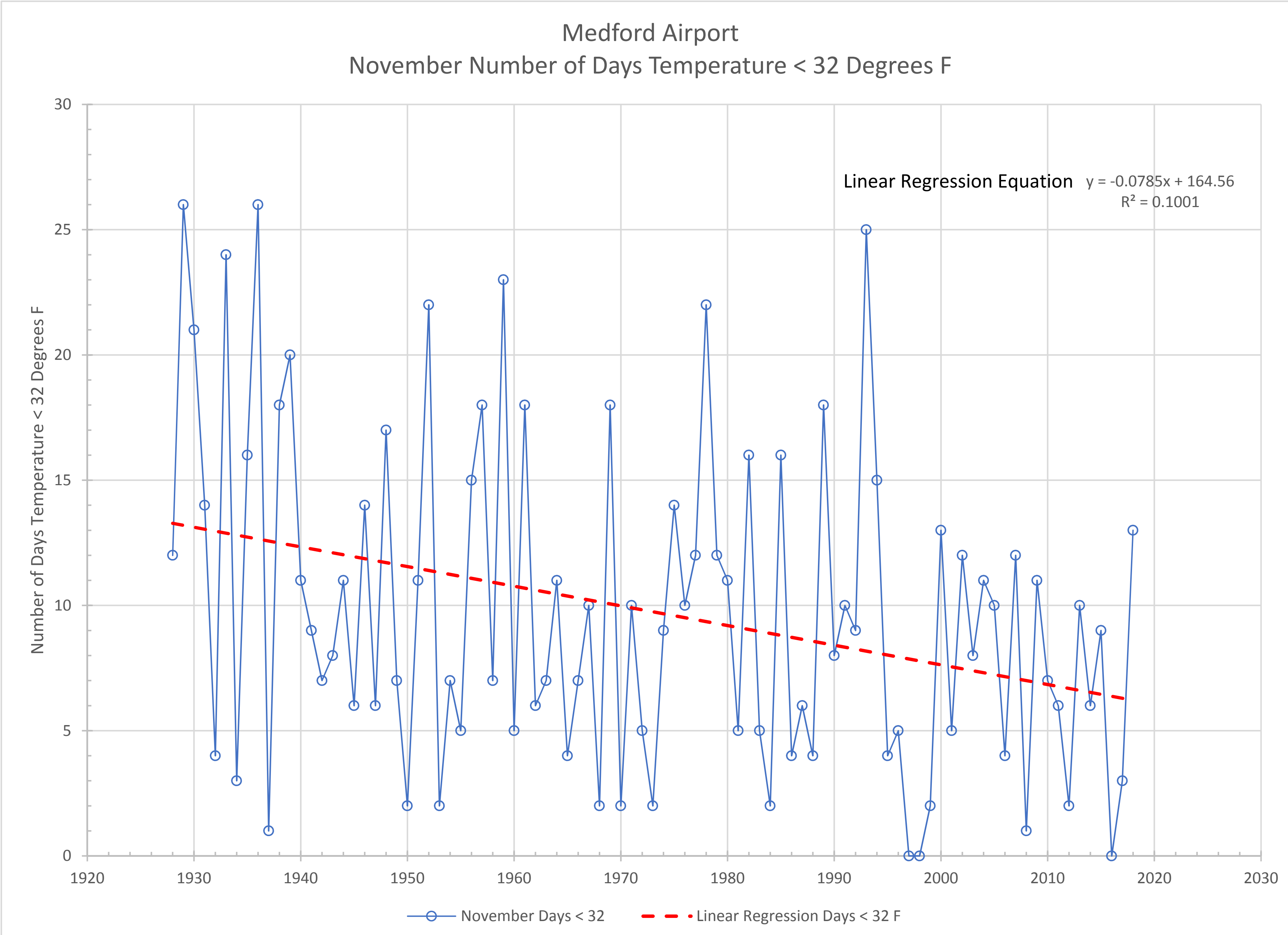

Medford Airport
Annual Number of Days Less than 32 Degrees
Linear Regression Equation
y = -0.2654x + 589.8
R² = 0.1318
Number of Days <32 Degrees F
120
100
80
60
40
20
0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Number of Days < 30
Linear Regression Days <32 Degrees

Figure 32



Statistical Analysis of the Medford Airport Temperature Data, 1928-2018