1. Intro
   1. Hello Zoo Keepers, My name is Andrew Estes. I am a master’s student who was asked to look at climate change and it’s impact towards how the zoo’s animals enclosures are built.
2. What I was asked to look at and how I looked at it
   1. While I lack much information (biometrics of the animals), I have helped build a jaguar enclosure at a zoo where my wife was the assistant deputy of operations. Hopefully my statistical background will spark some ideas for y’all to take back and possibly make some changes to the current animal habitats.
   2. I gathered temperature data from Camp Mabry and the Austin Airport to start my weather analysis.
3. Daily Temperature – scatterplot
   1. Looking at daily temperatures, there hasn’t been much variation. You can see though, that since 2000 there has been some relatively higher maximum temperatures. There is way too much information, or noise, to really look at in a graph for daily information so we can look at the temperature breakdown by decade
4. Temperature by decade – violin plot
   1. A violin plot shows the distribution of data. Think of Winnie the Pooh with his nice little potbelly. We can say most of his weight ( or data) comes from his middle section, meaning there are more pounds ( or data points) around the middle. The violin plot shape is the same thing – showing how the data gets more heavy at certain temperatures.
   2. Now, you’ll see within the violin plot a white box with a black bar in the middle. That represents the median, or middle, temperature. The black lines extending from the white box represent what we can safely consider normal temperatures.
   3. That means the dots extending beyond the lines are outliers – or statistical anomalies – like an albino python.
   4. In our graph, we see that the median temperature has remained roughly the same but that the maximum temperature is increasing – it has now broken 105 degrees for 4 straight decades and the lower temperatures are becoming statistical outliers.
5. Normalized temperature
   1. Temperature is expected to increase so what I did next was normalize the data. It’s like comparing obesity for a 5lb Rockhopper Penguin as compared to the 110 lb Spotted Hyena. A 120lb hyena may not be obese but a 15lb Rockhopper Penguin certainly is. We want to do the same thing with the data so we can see how far out the temperature is and it’s a pleasant surprise. The variation in temperature is actually decreasing over time.
   2. You may ask why all the doom and gloom with the colorful violin plot and then the good news with normalization. Welcome to statistics! Where nothing is clearcut and further interpretation is necessary. What if, for example, there is less variation because the minimum temperature is increasing more than the maximum temperature? Both temperatures are increasing at a high rate, but the gap between is lessening and as a result, there appears to be less variation and less cause for concern when the truth might be the opposite.
6. Precipitation – scappterplot
   * 1. We’ll move on from temperature to rain. You can see that there isn’t much rain in the state but there are some large amounts, once again post-2000 including 12+ inches in the mid 2015.
7. Normalized precipitiation
   1. We’ll look again at the normalized (Penguin vs Hyena) data for precipitation and you can see there is a lot of variation in recent years.
8. Snowfall – scatterplot
   1. Snowfall has actually decreased since 2000. But the highest snowfall recorded was in 2021.
9. Normalized snowfall
   1. Like precipitation, snowfall normalized has eclipsed the 4th standard deviation. Once every 43 years should the standard deviation be eclipsed.
10. Conclusions
    1. Animals are hardy creatures. But the things we build are not necessarily equipped to handle the swings in precipitation and snowfall. Furthermore, as temperatures increase and staying outside for long duration becomes unenjoyable, air cooled exhibits will become a good source of income from visitors and provide more enjoyable lifestyle for the animal.