MIST Project- Group 5

Liz Brown, Jessica Kondrat, Phu Nguyen, Adam Strogoff, Adelina Zaimi

Weather Bug: The Storm Will Provide

Overview:

Claremont Academy is a public school in Worcester. It was granted innovation status in 2016 – state has given us autonomy over curriculum, hiring, our mission and goals as a school. Claremont's College and Career Ready Characteristics - Reflect, Self-Monitor, Persevere - Collaborate - Communicate - Analyze/Problem Solve - Investigate/Research came out of this innovation plan. As we work through the grade-level standards, we build units and lessons with these characteristics in mind. We require all students to formally demonstrate their growth in each of these characteristics every two years (end of 8, 10, 12) through Gateway presentations. To achieve this, teachers implement various best practices and strategies. To improve our practice, teachers come together to create CLPs – Collaborative Lesson Plans – (exactly what we did in this institute).

Claremont Academy has a partnership with National Grid and other community organizations. Last year, National Grid installed a weather station on the school's roof to engage students in real-world applications of science technology as well as provide more accurate weather data for the city of Worcester. (Free app available to everyone!) It is part of the Weather Bug Achieve program for schools.

With this information, we, as teachers, are encouraged to explore ways to engage students with this data, where data analysis is so pertinent in our classrooms.

The Problem:

Claremont Academy is proud to begin its inaugural soccer season this fall! Since the sport is played outdoors, weather plays an important role in the success of the team. If the fall is rainy and cold, it may cause playing conditions to be unsafe (slippery turf, more injuries, hypothermia, etc.). If the fall is hot and sunny, players may be at risk of sunburn and dehydration. Additionally, the air temperature has a strong effect on the soccer ball itself. As the temperature increases, the pressure inside the ball increases, and vice versa. When the temperature is warm, it causes the air to expand and the ball can become slightly over-inflated. Cold temperatures cause the air to contract and under-inflate the ball. Wind speed can affect the path of the ball and the distance the ball travels. If our players fully understand these challenges in the climate, we can have an advantage over our opponents.

Background Resources: Weatherbug app data, Excel, weatherSTEM.com, AP stats book, basic knowledge of soccer

Mathematics Involved: MA math standards, , organize data and create graphical representations.

Grade 7/8: 8.SP.1. ***Construct and interpret scatter plots*** for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

8.SP.2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association***, informally fit a straight line***, and informally assess the model fit by judging the closeness of the data points to the line.

Grade 9: S.ID.1. Represent data with plots on the real number line (dot plots***, histograms***, and box plots).

S.ID. 2. Use statistics appropriate to the shape of the data distribution to compare ***center (median, mean) and spread (interquartile range, standard deviation)*** of two or more different data sets.

S.ID.3. ***Interpret differences in shape, center, and spread*** in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.ID. 4. ***Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages*.** Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Grade 10: S.CP.4. Construct and ***interpret two-way frequency tables of data when two categories are associated with each object being classified*.** Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.

Grade 11: S-IC.6. ***Evaluate reports based on data***

Grade 12 (AP Stats): S-ID. 4. Use the mean and standard deviation of a data set to fit it to a normal distribution and ***to estimate population percentages.*** Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Secondary Areas: use of Excel, TI-84 calculators

Expectations of Students:

Throughout the various grade level math classes, students will engage in activities using the WeatherBug data and explore statistical data analysis. The data would need to be updated to current climate readings. We feel the best way to engage the students is to relate the problem to something of interest to them. Our student population is highly interested in soccer which would hook their attention from the start of the problem.

Below are examples of the activities we would do at each grade-level.

Middle School (Grade 7 and Grade 8):

Game Time!

Starter: What is your favorite sport or physical activity? Describe why you enjoy it, how long you have participated in it, who you do it with.

_____
_____
_____
_____
_____

1. On a sheet of graph paper, create a scatter plot showing Average Temperature (degrees Fahrenheit) vs. Wind Gust (mph). Here is the data:

Date	Avg Temp degrees F	Wind Gust mph
9/1/17	63	26
9/2/17	58	25
9/3/17	48	28
9/4/17	59	19
9/5/17	63	18
9/6/17	64	29
9/7/17	71	25
9/8/17	75	26
9/9/17	83	20
9/10/17	79	23
9/11/17	72	17
9/12/17	64	21
9/13/17	63	23
9/14/17	65	12
9/15/17	73	25
9/16/17	76	31
9/17/17	73	25
9/18/17	69	25
9/19/17	70	18
9/20/17	75	22
9/21/17	76	28
9/22/17	71	21
9/23/17	65	20
9/24/17	63	31
9/25/17	63	25
9/26/17	66	21
9/27/17	74	22
9/28/17	75	30
9/29/17	77	25
9/30/17	73	23

2. What do you notice about the data in the scatter plot you graphed? What patterns do you see?

3. What does this information tell us about the soccer playing conditions and the effect the weather will have on the players, soccer ball?

4. Using a ruler, draw a line of best fit for the data in this scatter plot and determine the equation of this line. Write the equation here:

5. What are the slope and y-intercept of this line of best fit and what do they mean in the context of our soccer scenario?

Grade 9 (Algebra 1):

Our WeatherBug Climate Variations

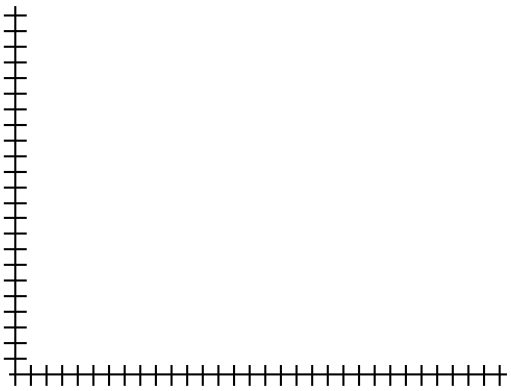
We will look at the data from our schools' weather station. In this activity we will describe distributions numerically. The chart below provides you with the average temperatures, the wind speeds and the humidity for the month of June.

DATE	AVERAGE TEMP (F)	WIND GUSTS (MPH)	HUMIDITY (%)
6/1/17	63.46	26.09	32.825
6/2/17	58.335	24.55	32.255
6/6/17	47.565	28.28	64.375
6/7/17	59.405	18.85	31.895
6/8/17	63.26	17.98	27.105
6/9/17	63.85	29.38	28.835
6/10/17	71.45	25.21	31.725
6/11/17	75.185	25.87	30.53
6/12/17	82.725	19.73	27.77
6/13/17	79.21	23.02	34.575
6/14/17	71.73	16.66	24.26
6/15/17	64.045	21.26	31.665
6/16/17	62.835	22.8	43.105
6/17/17	65.17	11.62	55.47
6/18/17	72.825	24.77	51.48
6/19/17	75.665	30.91	46.595
6/20/17	73.33	25.21	34.125
6/21/17	69.48	25.21	32.02
6/22/17	70.185	18.41	31
6/23/17	75.355	22.14	38.98
6/24/17	75.75	27.62	35.08
6/25/17	70.745	20.61	32.6
6/26/17	65.285	19.73	33.27
6/27/17	63.265	30.69	40.98
6/28/17	62.975	24.99	32.285
6/29/17	66.41	20.83	40.39
6/30/17	73.945	22.14	42.63

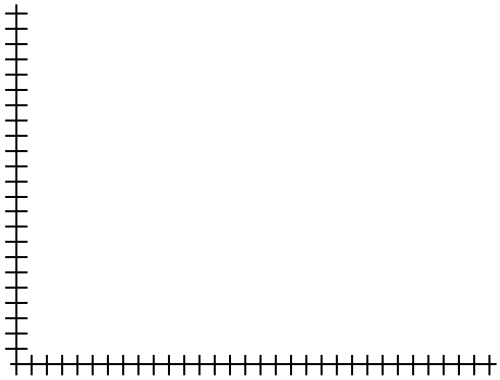
Normality check!

1. Generate a histogram for each variable to check if the data is distributed normally. (Use the graphing calculator). Sketch your histograms here:

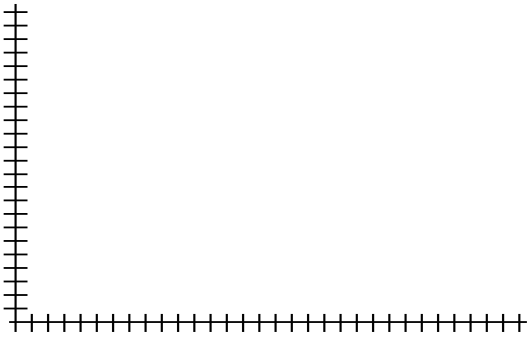
histogram 1 (temperature F)



histogram 2 (wind gusts MPH)



histogram 3 (humidity %)



2. Describe shape, center and spread for the distribution. Make sure to comment on any unusual features:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Comparison of Mean and Median for each variable

3. **a)** What is the mean value of temperature? _____ Median value of temperature?_____
Are these two values approximately the same? Yes or No (circle one).
Explain why _____

_____

b) What is the mean value of wind gusts? _____ Median value of wind gusts?_____
Are these two values approximately the same and explain why? Yes or No (circle one).
Explain why_____

_____

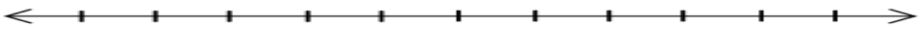
c) What is the mean value of humidity? _____ Median value of humidity?_____
Are these two values approximately the same and explain why? Yes or No (circle one).
Explain why_____

_____

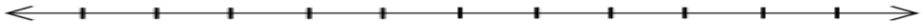
Symmetry Check

4. Complete the 5 number summary for the each of the data and draw their box plots

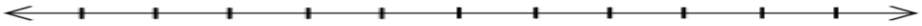
Temperature	
min	
Q 1	
median	
Q 3	
max	



Wind Gusts	
Min	
Q 1	
median	
Q 3	
Max	



Humidity	
min	
Q 1	
median	
Q 3	
max	



5. For the temperature, determine if the data are symmetric about the mean:

a) What is the "degree" value that marks the beginning of the second quartile? _____

b) What is the distance from the beginning of the second quartile to the median (temperature box plot)? _____

c) What is the "degree" value that marks the beginning of the fourth quartile?_____

d) What is the distance from the beginning of the fourth quartile to the median? _____

e) Are these two distances approximately the same in parts b) and d)? Yes or No (circle one).

Explain why_____

If the distances are approximately the same, then we can say that the data distribution is roughly symmetric.

Shape of the Data Distribution

6) Generate a stem-plot to assess the overall shape of the data distribution. Using the data for temperature (round to the closest whole number) create a stem plot below to show the shape of the distribution.

stem	Leaf

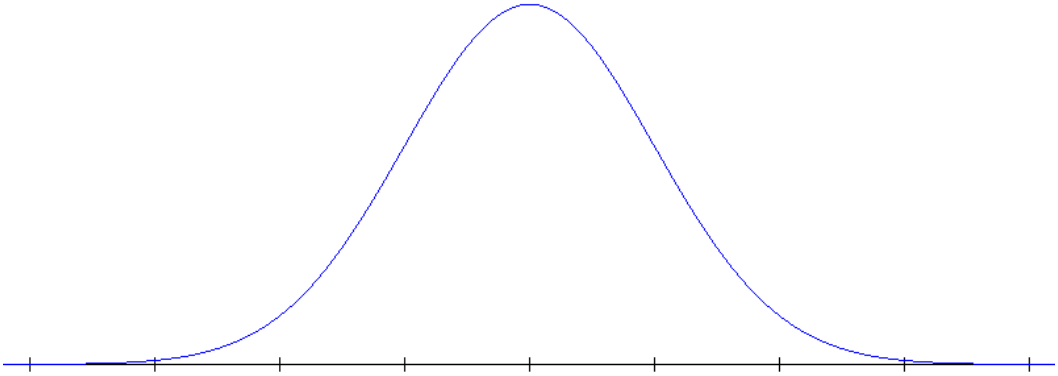
Is the data distribution approximately bell-shaped? Yes or No (circle one).

Explain why or why not:

_____

_____

7.) Assuming the data set for the class is approximately normal, construct the normal model for this data set. Make sure to include, statistics values, z-scores and percentiles



stats								
%ile								
z-score								

8. Answer the following questions:

a) What percent of the days had temperatures higher than 80° F? What is the z-score?
b) What percent of the days had temperatures are lower than 60° F? What is the z-score?

c) What percent of the days are between 60° F and 80° F? What are the z-scores?

d) What percent of the days had temperatures lower than 50° F? What is the z-score?

e) About what percent days had temperatures higher than 85° F? What is the z-score?

9. Answer these questions as well:

a) About how hot should a day be to be in the top 10 percent? _____
b) About how cold should a day be to rank in the lowest 5 percent?_____
c) In order to qualify for the "hottest days of the month" it's temperature should place above the 70^{th} percentile. How hot should it be? _____

d) What percent of the month would be able to qualify as the “the hottest days of the month”? _____

e) There are 30 days in June. About how many are warmer than 70° F? _____

Is there any day that would be considered unusually hot for the month? Support your answer.

_____

_____

_____

_____

Grade 10 (Geometry):

WeatherBug: The Weather Will Provide

In your group, discuss ways we could use weather data to predict whether the season will be successful or not based on the influences described above.

- Will we win more than 75% of our games? Why does your group think this way?

- What data could you use to support your prediction?

Our focus with the data: Precipitation and Humidity Levels

With 1 partner: Create a contingency table to explore relationships using the Weatherbug data on the next page.

	Rain	**No Rain**	**Totals**
Humidity above 50%			
Humidity below 50%			
Totals			

Based on this table, answer the following questions:

1. What percentage of days did it rain? _____
2. What percentage of days that rained had a humidity over 50%? _____
3. What percentage of days with a humidity over 50% rained? _____
4. What is the marginal distribution (break-down) of precipitation (rain)? _____
5. Write a sentence or two about the humidity level among the rainy days.
6. Do you think that the amount of rain is independent to the level of humidity? Support your answer with evidence from the contingency table.

WeatherBug data for May 2017 (This data would ideally be the fall dates from the year before (September 2016))

Observation I	Max Temp °F	Min Temp °F	Rain Month. in	Rain Year. in	Wind Gust mph	Last Light.	Min Pressure "Hg	Max Pressure "Hg	Min Humid %	Max Humid %
5/1/2017	55.33	43.12	0	11.05	13.37	06:15 PM	29.85	30.2	70.7	100
5/2/2017	69.9	42.33	0.13	11.18	27.4	06:40 PM	29.5	29.78	38.64	100
5/3/2017	57.47	46.27	0.13	11.18	33.32	05:44 AM	29.7	29.97	39.18	81.88
5/4/2017	65.79	40.54	0.13	11.18	21.92	05:58 AM	30.16	30.28	16.17	76.83
5/5/2017	48.02	44.25	1.01	12.06	21.92	05:44 PM	29.72	30.18	51.05	100
5/6/2017	66.02	46.72	1.28	12.33	33.76	06:45 PM	29.45	29.68	45.42	100
5/7/2017	60.44	49.87	1.28	12.33	30.47	06:26 PM	29.48	29.64	38.31	97.03
5/8/2017	48.97	38.84	1.28	12.33	27.18	06:07 AM	29.67	29.88	44.06	89.12
5/9/2017	51.84	37.28	1.28	12.33	13.59	06:38 PM	29.93	29.97	40.46	86.1
5/10/2017	55.33	40.98	1.28	12.33	15.78	06:14 AM	29.95	30	37.77	78.32
5/11/2017	60.84	44.64	1.28	12.33	17.32	06:12 AM	29.95	30.02	38.48	72.16
5/12/2017	57.3	42.67	1.28	12.33	13.37	07:00 PM	30.01	30.08	61.03	96.77
5/13/2017	54.31	42.95	1.29	12.34	18.63	06:11 PM	29.89	30.03	67.06	100
5/14/2017	49.64	39.24	2.74	13.79	30.25	07:00 PM	29.53	29.82	87.26	100
5/15/2017	60.11	44.42	2.95	14	30.25	06:44 AM	29.45	29.72	52.66	100
5/16/2017	76.37	50.88	2.95	14	24.33	07:56 PM	29.79	29.94	24.82	80.72
5/17/2017	89.59	58.25	2.95	14	28.72	06:03 AM	29.83	30	23.78	67.36
5/18/2017	91.62	69.22	2.95	14	31.79	05:37 AM	29.78	29.93	17.75	77.08
5/19/2017	85.7	64.95	3.04	14.09	28.5	05:46 AM	29.8	29.92	31.11	93.67
5/20/2017	71.25	51.11	3.04	14.09	17.1	05:49 AM	30.11	30.29	19.82	69.8
5/21/2017	69.96	45.77	3.04	14.09	13.59	05:27 AM	30.25	30.4	32.55	86.88
5/22/2017	54.6	47.45	3.1	14.15	15.78	06:05 PM	30.02	30.26	47.2	100
5/23/2017	69	49.2	3.15	14.2	12.93	05:32 AM	29.83	29.98	39.84	100
5/24/2017	68.67	53.7	3.15	14.2	16.44	06:43 AM	29.76	29.84	47.75	93.39
5/25/2017	54.94	49.64	3.46	14.51	24.99	06:25 PM	29.67	29.9	83.33	100
5/26/2017	56.63	45.88	5.32	16.37	25.65	07:44 AM	29.48	29.66	94.01	100
5/27/2017	70.12	51.17	5.32	16.37	17.32	05:50 AM	29.76	29.89	41.91	100
5/28/2017	70.12	55.28	5.32	16.37	15.78	07:00 PM	29.91	29.99	57.8	97.03
5/29/2017	55.05	47.96	5.44	16.49	16.44	06:34 PM	29.96	30.09	77.37	100
5/30/2017	60.23	46.44	5.44	16.49	13.15	06:43 PM	30.12	30.2	79.4	100

Grade 11 (Advanced Algebra):

DATA: WEATHER STATION FROM THE TOP OF OUR SCHOOL

Daily report on Temperature, F (high-low); Rain amount, in; Win gust, mph; Pressure, Hg (max-min); Humid, %.

MATH PROBLEM:

Students explore the given sets of data to make a general conclusion for their own statement or their chosen statement.

YOUR TASK:

1. Each group picks a statement from the list or you can make your own statement to explore the given data.
   a) Describe the relationship between daily temperature and daily pressure and support your conclusions with mathematical data, analysis and appropriate graph.
   b) Describe the relationship between daily temperature and wind gust and support your conclusions with mathematical data, analysis and appropriate graph.
   c) Describe the relationship between daily rain amount and daily humidity % and support your conclusions with mathematical data, analysis and appropriate graph.
   d) Describe the relationship between _____ and _____ and support your conclusions with mathematical data, analysis and appropriate graph.
   e) Or other form of statements

2. Using one of the followings (Range, Mean, Slope, Graphs, Rate of Change, Linear Regression, or any other background knowledge) or as many as you can to prove / describe your best solution / conclusions for your statement.

3. Presentation: Power point or Poster