Trigonometry and Statistics

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Unit 6 Normal Distribution **Level 3** **Approximately 20 days**

Stage 1 – Desired Results

Established Goals

2009 NJCCC Standard(s), Strand(s)/CPI #
(http://www.nj.gov/education/cccs/2009/final.htm)

Common Core Curriculum Standards for Math and English
(http://www.corestandards.org/)

Interpreting Categorical and Quantitative Data S-ID #2,4

Summarize, represent, and interpret data on a single count or measurement variable.

Making Inferences and Justifying Conclusions S-IC #1,3,6

- Understand and evaluate random processes underlying statistical experiments.
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

21st Century Themes
(www.21stcenturyskills.org)

___ Global Awareness
_x__Financial, Economic, Business and Entrepreneurial Literacy
___Civic Literacy
___Health Literacy
___Environmental Literacy

21st Century Skills

Learning and Innovation Skills:
_x__Creativity and Innovation
_x__Critical Thinking and Problem Solving
_x__Communication and Collaboration

Information, Media and Technology Skills:
___Information Literacy
___Media Literacy
_x__ICT (Information, Communications and Technology) Literacy

	Life and Career Skills: _x__Flexibility and Adaptability _x__Initiative and Self-Direction ___Social and Cross-Cultural Skills _x__Productivity and Accountability _x__Leadership and Responsibility
Enduring Understandings: *Students will understand that . . .* *EU 1*the distribution of data is used to model real world phenomenon. *EU 2*the normal distribution is a symmetric unimodal distribution . *EU 3*data of different units can be standardized. *EU 4*all data from samples of size 30 or more, regardless of population distribution, has an approximately normally distributed sampling.	**Essential Questions:** *EU 1* • What does a skewed distribution imply about the spread of data? • How can this be used to model real-world phenomenon? *EU 2* • What is the normal distribution and how can it be used to analyze data? • What does the normal distribution imply about the spread of data? *EU 3* • How can data be standardized to make comparisons? *EU 4* • Why is the normal distribution essential in the study of statistics? • How can technology be used to analyze data using the normal distribution?

Knowledge: *Students will know . . .*	**Skills:** *Students will be able to . . .*
EU 1 • the two types of skewness that apply to data • the skewness is effected by outliers.	*EU 1* • identify a distribution of data as symmetric or skewed. • identify outliers.
EU 2 • a normally distributed curve is symmetric and centered at the mean. • how the mean and standard deviation effect the distribution of data values for a normally distributed set of data.	*EU 2* • identify the characteristics of a normally distributed curve. • sketch a normal curve to represent a given situation.
EU 3 the standard normal distribution is an "even playing field" that allows comparisons to be drawn between normally distributed sets of data.	*EU 3* • calculate probability from scenarios involving z-scores in a standard normal distribution. • calculate z-score(s) from scenarios involving probability in a standard normal distribution.
EU 4 the area under the normally distributed curve is directly related to the probability of an occurrence or interval of occurrences.	*EU 4* • convert a data value from a normal distribution into a standard normal variable (z-score). • determine the occurrence or interval of occurrences that correspond to a certain probability for an approximately normal distributed set of data. • determine the probability of an occurrence or interval of occurrences for an approximately normal distributed set of data.

Stage 2 – Assessment Evidence

Recommended Performance Tasks:

EU 2 - the normal distribution is a symmetric unimodal distribution.

EU 4 - all data from samples of size 30 or more, regardless of population distribution, has an approximately normally distributed sampling distribution**.**

Go to the Sampling Distribution applet at http://onlinestatbook/stat_sim/sampling_dist/index.html. From the Population pull-down menu, select one of the predefined distributions. Click on animated sample a few times and watch what happens. Then try 5 samples, 1000 samples, and 10,000 samples. Adjust the sample size using the pull-down menu next to the distribution of sample means. Notice the values displayed to the left of the population distribution and the sample means distribution. Take a few more samples and watch how the values change. The purpose of this part is to get familiar and comfortable with the various features of this demonstration stack. There will be nothing to write up for Task 1.

Task2: Select the normal population. Record the population mean and population standard deviation. Specify sample size 2, and simulate 1000 samples of size 2. Record the sample mean and sample standard deviation. Compare the sample mean and sample standard deviation with the calculated value of $\sigma/\sqrt{n}$. Click on the CLEAR button, and repeat the process with new sample sizes of 9,16,25. Make a table or record all of the results for later analysis. What shapes do the sampling distributions have? As the sample size increases from 2 to 9 to 16 to 2, what is happening to the center of the sampling distribution? What is happening to the spread of the sampling distribution? What can be said about the quantity, $\sigma/\sqrt{n}$?

Task 3: One might suspect that sampling from an approximately normal distribution would produce an approximately normal sampling distribution. But if you start with a nonsymmetric distribution, would your sampling distribution be nonsymmetric, too? Select the “skewed” population, and repeat the steps of Task 2. Answer the same questions as before.

Task 4: This time, start with a custom-made population distribution. Repeat the steps of Task 2 and answer the same questions.

Task 5: Summarize what was learned by this investigation. In particular, make a conjecture that relates the mean of the sampling distribution to the population that has been drawn from. Also make a conjecture that relates the spread (i.e., standard deviation) of the sampling distribution to the host population. Finally, discuss how the shape of the sampling distribution relates to the shape of the parent population.

The Report: Describe the investigation in a report. Follow the conventions as described in the general guidelines for writing up Special Problems. Grading will be based on both accuracy and the quality of your written communication.

Other Recommended Evidence: *Tests, Quizzes, Prompts, Self-assessment, Observations, Dialogues, etc.*

- Assessment
  - identifying distribution as skewed/symmetric
  - properties of the normal distribution
  - find area/probability when given z-scores
  - find z-scores when given area/probability

- Assessment
  - conversion of data values to z-scores
  - finding probability when given data values
  - find data values when given probability
  - the Central Limit Theorem

- Cumulative Normal Distribution Unit Assessment

- Assessed elements from the performance task

- Other teacher-graded evaluations

Stage 3 – Learning Plan

Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: *Consider the WHERETO elements. Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

TI-Nspire Activity #1: Statistics: Z-Scores (M,T)

- Students will identify the percent of area under any normal curve that is 1, 2, or 3 standard deviation units from the mean.
- Students will recognize that for any member of the family of normal curves, the areas whose boundaries are the same number of standard deviations from the respective means of the curves are always equal.
- Students will reason abstractly and quantitatively (CCSS Mathematical Practices).
- http://education.ti.com/calculators/timathnspired/US/Activities/Detail?sa=5026&t=1192&id=13318

TI-Nspire Activity #2: Statistics: Normal Probability Plot (M,T)

- Students will identify the shape of a distribution as being skewed or mound-shaped and approximately symmetric.
- Students will recognize that a normal probability plot of skewed data is nonlinear and either concave up or concave down.
- Students will recognize that a normal probability plot of approximately normal data is approximately linear.
- Students will identify outliers on a normal probability plot.
- Use appropriate tools strategically (CCSS Mathematical Practices).
  http://education.ti.com/calculators/timathnspired/US/Activities/Detail?sa=5026&t=1192&id=16925

Critical Vocabulary:
symmetric
skewness
unimodal
continuous random variable
z-score
sampling distribution
standard error

Below is the suggested sequence of learning activities and number of days for the Trigonometry and Statistics. Adjustments should be made accordingly to level.

Approximate timeline for Level 3: 20 Days

Students will

- **Identify distributions as skewed/symmetric based on visual representations of the data (**
- **Ti-Nspire Activity 2 (M)**
- **Apply the properties of the normal distribution to find the probability of a data point falling in a particular interval**
- **Ti-Nspire Activity 1 (M,T)**
- **Find area/probability when given z-scores (A,M)**
- **Find z-scores when given area/probability (A,M)**
- **Convert data values to z-scores to utilize the properties of the normal distribution (A,M)**
- **Find probability when given data values (A,M)**
- **Find data values when given probability (A,M)**
- **Apply the Central Limit Theorem to sets of sample data to make inferences regarding the population of interest (A,M,T)**