Georgia Association of Advanced Placement Math Teachers

CSI:
The Calculus/Statistics Insider

The Official Newsletter of the
Georgia Association of Advanced Placement Math Teachers
Spring 2013

Table of Contents

Letter from the President

Once again it is that time of year. The year-long work with our students will be tested as they take their AP exams. Many of us are looking once more at the best way to review our students and help them fine-tune their knowledge. Justifying their answers is one of the hardest parts for students to get credit for what they know. In this edition of the newsletter you will find some resources for preparing your students for an upcoming exam. Looking at past copies of the newsletter may give additional ideas and assistance.

Hopefully you were able to attend last fall's GMC. Great speakers helped all of us that were in attendance. The GAAPMT board is planning another great conference this October and we hope to see you there.

The newsletters and the upcoming conference are provided as ways to help all of us continue to improve. Hopefully you will find the resources offered here a help for now and for the future. We wish you and your students much success on the upcoming AP exams!

Carolyn Thigpen
GAAPMT President 2011-2013

Report from the 2012 GAAPMT Annual Conference at Rock Eagle

The GAAPMT Annual Meeting at Rock Eagle last October 2012 was a big success! We had over 80 members in attendance for the day-long meeting. The large crowd was attracted by the high profile speakers who were presenting.

In the morning, Benita Albert from Oak Ridge High School spoke on Inverse Functions and Differential Equations. Marshall Ransom from Georgia Southern University presented a session on "Interesting Integrals". The AP Statistics teachers heard from Daren Starnes of The Lawrenceville School in New Jersey and Landy Godbold of The Westminster Schools in Atlanta. Daren spoke about Inference from Sampling and Experiments. Landy's topic was "Visualizing Difficult Topics in Statistics".

After a delicious lunch buffet donated by Bedford Freeman Worth Publishers, the business meeting was held. At the conclusion of the meeting, Chris Harrow was presented with the John Neff Award in recognition of his contributions to AP Mathematics in the state of Georgia.

In the afternoon, the AP Calculus and AP Statistics teachers split up to hear from current readers about the 2012 exam and grading rubrics.

A survey of those in attendance was handed out at the end of the conference. The sessions, speakers, and the newsletter received high marks. Attendees also indicated that they highly value the connections they establish with other AP colleagues through GAAPMT.

GA^{2}PMT Officers for 2013-2014

At the Rock Eagle conference in October, we will be voting on a new slate of officers to lead us for the next 2 years. If you would like to nominate yourself or someone else for one of the positions below, please email Carolyn Thigpen at cthigpen@gwa.com.

- President
- President-Elect
- Secretary/Treasurer
- Vice-President of Communications
- Vice-President of AP Info
- Vice-President of Technology
- Regional Representatives

Annual Meeting at Rock Eagle
Friday, October 18, 2013

Tentative Schedule:

<table>
<tr><td></td><td colspan="2">Registration Begins</td><td></td></tr>
<tr><td></td><td>Back Room
2 90 minute</td><td>Left Room
3 hour sessions</td><td>Right Room
3 hour sessions</td></tr>
<tr><td></td><td>8:00 – 9:30
Sandy Burlingame “Fun Activities for Calculus”</td><td rowspan="3">Josh Tabor and Chris Franklin – AP Statistics</td><td>8:00 – 9:00
Nurfatimah Merchant - Sequences and Series</td></tr>
<tr><td></td><td rowspan="2">9:45 – 11:15
Marshall Ransom and Chuck Garner – AP Calculus</td><td>9:15 – 10:15
Chris Parker- AP Statistics</td></tr>
<tr><td></td><td>10:30 – 11:30
Loretta Cameron & Debbie Kohler – Slope fields</td></tr>
<tr><td>12:00 – 1:00</td><td colspan="3">Business Meeting and Luncheon</td></tr>
<tr><td>1:00 – 3:00</td><td>Report from the AP Calculus Reading</td><td>Report from the AP Statistics Reading</td><td></td></tr>
</table>

To attend the free luncheon and afternoon AP sessions, you must be a current GAAPMT member. You may mail in your dues using the form at the end of the newsletter or pay at the door. To reserve your spot for the luncheon, please email Storie Atkins at satkins@mcsdga.net before October 2!

Finishing with a Flourish: Final Projects in AP Statistics

Daren Starnes, Math Department Chair, The Lawrenceville School

What should you do with your students after the AP Statistics exam? One option is to cover additional content, like multiple regression or analysis of variance. This "more of the same" approach may not appeal much to students who have just prepared for and taken the AP exam, or to seniors who are looking forward to life after graduation. A much-less-serious option is to show statistics-related videos. Doing so would pass the time, but may not result in much student engagement. An appealing alternative that allows students to pursue questions of interest while applying what they have learned in the course is an end-of-year project.

Student projects can serve as an effective capstone experience that reinforces the statistical problem solving process: ask questions, collect data, analyze data, and interpret results.[1]

- **Step 1: Ask questions.** Each team of students develops a research question and proposes a plan for collecting and analyzing data to help answer the question. For an end-of-year project, the research question ought to involve inference. Proposals should be submitted to you for careful review, feedback, and possible revision.
- **Step 2: Collect data.** The team carries out its approved data collection plan. All teams should submit their raw data to you for verification.
- **Step 3**: **Analyze data.** Team members summarize the data graphically and numerically, and then perform inference.
- **Step 4: Interpret results.** The team describes what its analysis reveals about the research question.

Another important decision that needs to be made is what "artifacts" each team will submit at the end of the project. Will students write a paper, make a poster, film a video, give a presentation to their classmates? Do you want teams to enter their projects into the American Statistical Association's Project Competition? If so, students must produce a project report that follows the competition's guidelines. Visit www.amstat.org/education for more information.

1. Adapted from *Guidelines for Assessment and Instruction in Statistics Education,* The American Statistical Association, 2006.

The scope of a final project should align with the amount of time available for students to complete it. Be sure to consider how much time you can allocate both before and after the AP exam. One way to adjust the time required for successful completion of the project is to alter the end product that students must generate. Student presentations will require several class periods, so budget time accordingly.

My best advice from doing end-of-year projects with my classes is to build a schedule that requires teams to start early and to submit components of the project at carefully chosen checkpoints along the way. This way you can monitor progress, give timely feedback, and likely improve the quality of the finished product. Devote several class periods for students to work on their projects and for you to meet with individual teams. A sample final project timeline is included for your reference at the end of this article.

What about grading? If you scaffold the project as suggested earlier, you can evaluate each component as part of the final grade. Teams can use your feedback to correct their mistakes before submitting their finished products. Consider weighting earlier components less heavily in the grade than the artifacts so that students have an incentive to get things right in the end. Incorporate student evaluations of in-class presentations as a means for keeping everyone engaged. The final project timeline at the end of the article includes grading suggestions.

A final issue to consider is whether to impose any limitations on the type of project that students can propose. Will you permit teams to do a survey, an observational study, or an experiment? Can the team's research question involve any type of inference that you have covered in the course? Do you plan to "seed" some possible topics/questions, or to let students brainstorm freely? Check with your administration about any restrictions on student research at school. And be sure to stress ethical data collection with your students.

One of my all-time favorites is Josh Tabor's *Survey Bias Project*, which has students design and carry out a randomized experiment that involves manipulating one aspect of a survey. Teams can change question wording, interviewer appearance, administration method, and so on to create two different versions of the survey for comparison. Then students use appropriate inference techniques to see if there is convincing evidence that the change caused a significant difference in responses for the two versions. More information about this project can be found after the grading rubric or at the end of Chapter 4 in *The Practice of Statistics,* 4th edition.

AP Statistics Final Project

One of the culminating experiences of this class is the process of preparing for and taking a cumulative assessment on your ability to apply what you have learned about data production, data analysis, probability models, and inference. Now we turn to what is arguably the more important culminating activity—the final project. This project will give you an opportunity to design and carry out a statistical study on a topic that interests you and the members of your team. The following outline describes the key components of the project and provides a timeline for getting your work completed successfully. Remember: this is your last, best chance to demonstrate the full extent of what you have gained from this course. *Also note: we will be submitting your completed project to the American Statistical Association's Project Competition.*

I. Choose a research question and teammates; develop a study design plan
Your first task is to develop your research question. You need to ensure that the scope of the question is not too large for the time available to complete the project. Your question must involve inference.

Project Proposal due Monday, April 20 at the beginning of class <15 points>
Your proposal must include:

- Team members' names
- The research question you have chosen, clearly stated
- Why you chose this particular question—a rationale for carrying out the study
- Will you conduct an experiment, a survey, or an observational study? How will random selection and/or random assignment be incorporated in your design? What steps will you take to reduce bias? How many individuals will participate in your study? What variable(s) will you measure? How will you analyze the data?

Project implementation plan due Monday, May 11 at the beginning of class <20 points>
Your implementation plan must include:

- Your finalized research question and team members
- A *complete* description of your plan for collecting, analyzing, and drawing conclusions from data. Be specific!

II. Implement your plan and collect your data
Be sure to follow your design plan carefully to avoid introducing any bias! Maintain confidentiality and anonymity of all individuals.

Raw data submitted to me by Monday, May 18 at the beginning of class. <20 points>

III. Analyze your data

- Organize the data
- Perform exploratory data analysis: graphs, numerical summaries, interpretation
- Use appropriate inference method(s) to help answer your research question.

IV. Interpret results in context

- Develop a one-paragraph abstract, suitable for the start of a journal article, summarizing your study.
- Describe any obstacles/challenges you encountered during the project and how you resolved each of them.
- Discuss possible extensions of your research project.

Project status report due at the beginning of class on Monday, May 18. <20 points>

Project written report due by the beginning of class on Monday, May 25 <100 points>
Your report will be evaluated on the accuracy of your statistical methodology as well as the clarity of your statistical thinking. Organization and appearance count! Be sure to address any obstacles/challenges you faced, as well as possible extensions of your research.

Oral presentation May 25-27 <25 points>
10 to 15 minute report describing major aspects of your study

AP Statistics

Survey Bias Project[2]

The Project: Working in groups of two, you will design and conduct an experiment to investigate the effects of response bias in surveys. You may choose the topic for your surveys, but you must design your experiment so that it can answer at least one of the following questions.

- Can the wording of a question create response bias?
- Do the characteristics of the interviewer create response bias?
- Does anonymity change the responses to sensitive questions?
- Does providing extra information affect the responses?

This project consists of 3 parts. Interim deadlines are included to help keep you on track.

Proposal (20%): Your group must submit a completed project proposal form that outlines your survey question and the details of your experimental design. The proposal is worth 20% of the total grade so don't treat it casually. The proposal is due for approval no later than _____. **You may not start your project until it has been approved.**

The written report (40%): I will need to sign off on your collected data no later than _____. (Do not start writing your report until I have done so). The written report must be typed and graphs should be done on the computer. The report is due no later than _____, and should include the following sections (clearly labeled).

- **Introduction:** What form of bias were you investigating? Why did you choose the topic you chose for the survey? What results do you expect?
- **Methodology:** Describe how you conducted your experiment and why you think your design was effective. *Note:* This section should be very similar to your proposal.
- **Results:** Present the data in both tables and graphs in such a way that conclusions can easily be made. Make sure to label the graphs/tables clearly and consistently.
- **Conclusions:** What conclusions can be drawn from your experiment? Be specific.
  Were the results as you had anticipated?
  Did you encounter any problems during your project?
  Would you do anything different if you were to repeat your experiment?
  What did you learn from this project?

You may not start your poster until you have received feedback on your written report.

Poster (40%): Due _____. Poster Presentations will be made to your classmates on _____. That week, posters will be displayed for your fellow students to enjoy. The poster should completely summarize your project yet be simple enough to be understood by a student who has had no formal statistics instruction.

Your poster should include:

- Title and objective: the type of response bias investigated and the survey questions.
- Data collection methods: how you used control, blocking, randomization.
- At least 2 visuals: experimental design schematic (required), graphs, tables, digital photos.
- Results and conclusions.

2. Thanks to Aggi Dellevoet, my colleague at Lawrenceville, for developing this version of the project handout.

Scoring Rubrics

The written report will be scored for AP appropriate content and accuracy.

Introduction	Form of Response Bias Topic choice & reasoning	**15%**
Methodology	Setup of randomized comparative experiment Appropriate use of control, random assignment, and replication Appropriately labeled experimental design diagram	**30%**
Results	Data collection results displayed in appropriate tables and graphs	**15%**
Conclusion	Interpret results back to original form of response bias Discussion of problems encountered Changes that would be made if experiment was repeated What was learned	**40%**

The poster will be scored for clarity, communication and visual appeal.

Title and Objective	survey question and type of response bias	**15%**
Data Collection Methods	brief discussion of how the experiment was carried out	**25%**
Visual Aids	experimental design diagram, graphs, pictures	**25%**
Results and Conclusions	clear and concise	**15%**
Visual Appeal	clean, professional and fun to look at	**15%**

Examples of Successful Projects: (from Josh Tabor)

Milk vs. Orange Juice

1. Which do you prefer, milk or orange juice, as a breakfast drink? (milk: 14%)
2. Milk contains high levels of vitamin D and calcium. Do you prefer milk or orange juice as a breakfast drink? (milk: 64%)

Cheating

1. Do you cheat in class? (anonymous: 47% would)
2. Do you cheat in class? (not anonymous: 15% would)

Make-Up (all questions asked to males)

1. Do you find females who wear makeup attractive? (wearing makeup: 75% yes)
2. Do you find females who wear makeup attractive? (without wearing makeup: 30% yes)

Time Online

1. On average, how many hours a week do you spend online: 0-5, 6-10, 11-16, 17-25, 26-35, or more?
2. On average, how many hours do you spend online each week: 0-5, 6-10, 11-16, or more?

(For this question, the students anticipated that subjects would be embarrassed to put more. In the first question, 50% answered over 17 hours, but in the second question, 0% did.)

AP Statistics Project Proposal Form Names: _____
Bias in Surveys

Each group of two must turn in one project proposal form. Attach extra sheets if necessary.

1. Which of the following four questions are you seeking to answer with your surveys?
   - ☐ Can the wording of a question create response bias?
   - ☐ Do the characteristics of the interviewer create response bias?
   - ☐ Does anonymity change the responses to sensitive questions?
   - ☐ Does providing extra information affect the responses?

2. Write down your survey question and describe changes you will make to the question, to the interviewer's appearance, or to the survey design in order to affect the changes you hope to observe in #1.

3. What are your anticipated results?

Outline of Experimental Design

4. How will you obtain your subjects for this experiment? (You must use a minimum of 30 subjects.)

5. Describe how you will carry out your experiment. Be specific! Include a diagram of your experimental design if you wish. Explain how your design addresses the issues of **control** and **random assignment**. Be sure to discuss your survey administration method (in person, paper ballot, Survey Monkey, etc.) in detail.

Hints for Success on the AP Statistics Exam
Compiled by Zack Bigner

The Exam

The AP Stat exam has 2 sections that take 90 minutes each. The first section is 40 multiple choice questions, and the second section is 6 free response questions. Each section counts for half of the overall score. The last free response question counts for 25% of the Section II score. You are allowed to use your calculator(s) throughout the exam, and a standard set of formulas and tables is printed right in the test booklet for your use.

General tips for writing Free Response Answers:

Understand your obligation as a test taker
You are being evaluated not only on the correctness of your answers, but also on your ability to communicate the methods you used to reach them. The answer is everything you write down, not just the last line or number at the end. Convince the reader that you understand the key concepts in the question. Don't just give them the numbers and hope they will assume you understand the concepts.

Be smart about multi-part questions
Most AP Stat questions have several parts. Read all the parts before you start answering and think about how they might be related (sometimes they aren't). If the last part asks you to answer a question based on your results to the previous parts, be sure to actually use your prior results to answer. If you couldn't do one of the previous parts, make up an answer and explain what you would have done.

Answer the question you are asked
The test writers spend over a year writing these questions. They word them carefully and specifically. Spend more time reading and less time writing to make sure you really understand what is being asked. When you have answered the question asked, stop writing. They give you much more space than you need. Don't panic because you haven't used all the space provided.

Answer in context
Most, if not all, AP Stat problems will have a real life context. Make sure your answers include the context. This is especially important when defining symbols/variables and writing conclusions.

Use vocabulary carefully
This isn't English class. There's no poetic license here. Terms like normal, independent, and sampling distribution have specific meanings. Don't say "normal" if you mean "approximately normal" and don't mix up populations and samples in either words or symbols.

Leave enough time for the last question
The last free response question counts for more points and is designed to take 20 to 30 minutes. At least read it first, and if you feel OK about it, go ahead and answer. If it looks hard, you can save it for the end, but no matter what, when there are 30 minutes left in the test, stop and go to the last question.

Relax
Having met many of the people who write the exam and grading standards, I can assure they are not out to trick you. They write challenging but straightforward questions designed to give you an opportunity to demonstrate what you have learned. Seize the opportunity and do your best. Keep in mind that you only need to earn roughly 65 to 70% (it varies from year to year) of the points on the exam to get a 5.

Collecting Data
There are 2 broad areas of data collection we cover in AP Stat, Experiments and Sampling. You are expected to know some general concepts and specific techniques related to each area.

Experiments vs. Samples
Many students confuse experimentation with sampling or try to incorporate ideas from one into the other. This is not totally off-base since some concepts appear in both areas, but it is important to keep them straight. The purpose of sampling is to estimate a population parameter by measuring a representative subset of the population. We try to create a representative sample by selecting subjects randomly using an appropriate technique. The purpose of an experiment is to demonstrate a cause and effect relationship by controlling extraneous factors. Experiments are rarely performed on random samples because both ethics and practicality make it impossible to do so. For this reason, there is always a concern of how far we can generalize the results of an experiment. Generalizing results to a population unlike the subjects in the experiment is very dangerous.

Blocking vs. Stratifying
Students (and teachers) often ask, "What is the difference between blocking and stratifying?" The simple answer is that blocking is done in experiments and stratifying is done with samples. There are similarities between the two, namely the dividing up of

subjects before random assignment or selection, but the words are definitely not interchangeable.

Blocking

In blocking we divide our subjects up in advance based on some factor we know or believe is relevant to the study and then randomly assign treatments within each block. The key things to remember:

1. You don't just block for the heck of it. You block based on some factor that you think will impact the response to the treatment
2. The blocking is not random. The randomization occurs within each block essentially creating 2 or more miniature experiments.
3. Blocks should be homogenous (i.e. alike) with respect to the blocking factor.

For example, I want to find out if playing classical music during tests will result in higher mean scores. I could randomly assign half my students to the room with the music and the other half to the normal room, but I know that my juniors consistently score higher than my seniors, and I want to account for this source of variation in the results. I block according to grade by separating the juniors and seniors first and then randomly assigning half the juniors to the music room and the other half to the normal room. I do the same with the seniors. For this design to be valid, I have to expect that each grade will respond to the music similarly. In other words, I know that juniors will score higher, but I expect to see a similar improvement or decline in both groups as a result of having the music. At the end of my study I can subtract out the effect of grade level to reduce the unaccounted for variation in the results.

You have learned how to analyze the results of one special type of blocked design, namely, matched pairs. In matched pairs you subtract each pair of values which eliminates the variation due to the subject. Similar techniques are available for fancier blocked designs.

Stratified Sampling vs. Cluster Sampling

Many students confuse stratified and cluster sampling since both of them involve groups of subjects. There are 2 key differences between them. First, in stratified sampling we divide up the population based on some factor we believe is important, but in cluster sampling the groups are naturally occurring (I picture schools of fish). Second, in stratified sampling we randomly select subjects from each stratum, but in cluster sampling we randomly select one or more clusters and measure every subject in each selected cluster. (Note: There are more advanced techniques in which samples are taken within the cluster(s).)

Final Thoughts

It is especially important to stay focused when answering questions about design. Too many students get caught up in minor details but miss the big ideas of randomization

and control. Always remember that your mission in responding to questions is to demonstrate your understanding of the major concepts of the course.

Describing Data:

IQR is a number
Many students write things like "The IQR goes from 15 to32". Every AP grader knows exactly what you mean, namely, "The box in my boxplot goes from 15 to 32.", but this statement is not correct. The IQR is defined a Q3 - Q1 which gives a single value. Writing the statement above is like saying "17 goes from 15 to 32." It just doesn't make sense.

Be able to construct graphs by hand
You may be asked to draw boxplots (including outliers), stemplots, histograms, or other graphs by hand. The test writers have become very clever and present problems in such a way that you cannot depend on your calculator to graph for you.

Label, Label, Label
Any graph you are asked to draw should have clearly labeled axes with appropriate scales. If you are asked to draw side-by-side boxplots, be sure to label which boxplot is which.

Refer to graphs explicitly
When answering questions based on a graph(s), you need to be specific. Don't just say, "The female times are clearly higher than the male times.", instead say, "The median female time is higher than the first quartile of the male times." You can back up your statements by marking on the graph. The graders look at everything you write, and, often, marks on the graph make the difference between 2 scores.

Look at all aspects of data
When given a set of data or summaries of data, be sure to consider the Center, Spread, Shape, and Outliers/Unusual Features. Often a question will focus on one or two to these areas. Be sure to focus your answer to match.

It's skewed which way?
A distribution is skewed in the direction that the tail goes, not in the direction where the peak is. This sounds backwards to most people, so be careful.

Slow down
The describing data questions appear easy, so many students dive in and start answering without making sure they know what the problem is about. Make sure you know what

variable(s) are being measured and read the labels on graphs carefully. You may be given a type of graph that you have never seen before.

Inference:

Not every problem involves inference
You have spent most if not all of this semester on inference procedures. This leads many students to try to make every problem an inference problem. Be careful not to turn straightforward probability or normal distribution questions into full-blown hypothesis tests.

Hypotheses are about populations
The point of a hypothesis test is to reach a conclusion about a population based on a sample from it. We don't need to make hypotheses about the sample. When writing hypotheses, conclusions, and formulas, be careful with your wording and symbols so that you do not get the population and sample mixed up. For example, *don't* write "Ho: $\bar{x}$ = 12" or "μ = mean heart rate of study participants".

Check Assumptions/Conditions
Checking assumptions/conditions is not the same thing as stating them. Checking means actually showing that the assumptions are met by the information given in the problem. For example, don't just write "np>10". Write "np=150(.32)=48>10". Everyone knows you can do the math in your head or on your calculator, but writing it down makes it very clear to the reader that you're tying the assumption to the problem rather than just writing a list of things you memorized.

Confidence intervals have assumptions too
Confidence intervals have the same assumptions as their matching tests, and you need to check them just as carefully.

Link conclusions to your numbers
Don't just say "I reject Ho and conclude that the mean heart rate for males is greater than 78." This sentence doesn't tell us why you rejected Ho. Instead, say "Since the p-value of .0034 is less than .05, I reject Ho and ..."

Be consistent
Make sure your hypotheses and conclusion match. If you find an error in your computations, change your conclusion if necessary. Even if your numbers are wrong, you will normally get credit for a conclusion that is correct for your numbers. If you get totally stuck and can't come up with a test statistic or p-value, make them up and say what you would conclude from them.

Interpreting a confidence interval is different than interpreting the confidence level

Interpreting the confidence interval usually goes something like, "I am 95% confident that the proportion of AP Statistics students who are highly intelligent is between 88% and 93%" or "The superintendent should give seniors Fridays off since we are 99% confident that between 72% and 81% of parents support this plan."

Interpreting a confidence level usually goes something like "If this procedure were repeated many times, approximately 95% of the intervals produced would contain the true proportion of parents who support the plan."

Regression:

Graph First, Calculate Later

The most important part of the regression process is looking at plots. Regression questions will frequently provide a scatterplot of the original data along with a plot of residuals from a linear regression. Look at these plots before answering any part of the question and make sure you understand the scales used.

Is it linear?

Remember that an r value is only useful for data we have already decided is linear. Therefore, an r value does not help you decide **if** data is linear. To determine if data is linear, look at a scatterplot of the original data and the residuals from a linear regression. If a line is an appropriate model, the residuals should appear to be randomly scattered.

Computer Output

It is very likely that you will be given computer output for a linear regression. If you can read the output correctly, these questions are normally easy. You should be able to write the regression equation using the coefficients in the output and also be able to find the values of r and r2. Most software packages provide the value of r2. If you are asked for the value of r, you will need to take the square root and look at the slope to determine if r should be positive or negative.

Interpreting r

If asked to interpret an r value, be sure to include strength, direction, type, and the context. A good interpretation will be something like, “There is a weak positive linear relationship between the number of math classes a person has taken and yearly income.” After you get a 5, be sure to take more statistics in college.

The Remainder for a Taylor Series

By Marshall Ransom
Georgia Southern University

Some vocabulary:

(1) The sum of the terms of a Taylor Series up to a power of x of n is referred to as P_n.

(2) The remainder (this is the error in estimating the infinite sum) is referred to as R_n.

(3) $R_n \le \dfrac{\overset{\max}{f^{(n+1)}}}{(n+1)!}\left|x-a\right|^{n+1}$ This means that you have to find the maximum possible value of the NEXT derivative. Examples are shown below.

Example 1: $\sin(x) = x - \dfrac{x^3}{3!} + \dfrac{x^5}{5!} - \dfrac{x^7}{7!} + \ldots$

Therefore, $P_5 = x - \dfrac{x^3}{3!} + \dfrac{x^5}{5!}$ for this series, which is centered at $a = 0$.

The remainder $R_5 \le \dfrac{\left|\overset{either}{\sin \text{ or } \cos}\right|}{(5+1)!}\left|x-a\right|^{5+1} \le \dfrac{1\left|x-a\right|^6}{6!}$.

To estimate the remainder (error) in using this series to calculate sin(0.1), we let $x = 0.1$ and $a = 0$.

The remainder is $\dfrac{1\left|0.1-0\right|^6}{6!} = \dfrac{1}{1,000,000} \bullet \dfrac{1}{720} = \dfrac{1}{720,000,000}$.

Example 2: $f(x) = \cos(2x)$ centered at $x = \dfrac{\pi}{4}$ is given by

$-2\left(x-\tfrac{\pi}{4}\right) + \dfrac{2^3}{3!}\left(x-\tfrac{\pi}{4}\right)^3 - \dfrac{2^5}{5!}\left(x-\tfrac{\pi}{4}\right)^5 + \ldots.$

(We will derive this in class.) Since $\dfrac{\pi}{4} \approx 0.79$, we could get a good approximation for values of x close to 0.79. Using this series, how accurate would be an approximation to cos(2x) if $x = 0.8$? We will assume that since the center is $\dfrac{\pi}{4} \approx 0.79$, $\left|x-a\right| = \left|0.8-.79\right| \le 0.01$.

Suppose that we use P_5 to approximate $f(0.8)$. What is the remainder? (Remember, this means the maximum error between this estimate and the infinite sum.)

$$R_5 \le \frac{\left|\overset{\max/either}{\sin \text{ or } \cos}\right| \bullet 2^{5+1}}{(5+1)!}\left|x-a\right|^{5+1} = \frac{2^6}{6!} \bullet \left|0.8-0.79\right|^6 = \frac{2^6(0.01)^6}{6!} = \frac{64}{6!(1,000,000,000,000)} = \frac{4}{45,000,000,000,000}$$

Note that this means $\left|P_5(0.8) - f(0.8)\right| \le \frac{4}{45,000,000,000,000} \approx 0.00000000000009$. Also note that since the next term is 0, we could use R_6 to estimate the remainder and get an even better result.

Conferences of Interest

It's that time again! 2013 Summer TI-Nspire Workshops

Through hands-on, subject-specific training, new and experienced educators learned how to integrate TI technology into their teaching and use the latest graphing technology to encourage student exploration of math and science concepts. The workshops are a great opportunity to get started or enhance your present experience! You also get your very own choice of calculator (TI Nspire *or* TI-84) and accompanying Teacher Software included in the course cost.

2013 Summer Workshop Costs and Inclusions

$350: includes one of the following teacher bundles depending on the type of workshop attended:

- a TI-Nspire™ CX or TI-Nspire™ CX CAS handheld and TI-Nspire™ Teacher Software, or
- a TI-84 Plus C Silver Edition graphing calculator and TI SmartView™ Teacher Software

$300: workshop without technology
$125: Pre-service teacher price including technology

Click http://education.ti.com/en/us/pd/in-your-area/summer-workshops to look at all of the strands we are offering this summer in GA, AL, and MS. One that's sure to be a popular class is the "Implementing the Common Core Mathematical Practices with TI-Nspire Technology" class.
If you are traveling this summer please check out the other host cities at http://education.ti.com/calculators/pd/US/In-Your-Area/Summer-Workshops.

Specific courses offered Summer 2013 and Locations and Dates:

Alabama (Athens)
June 11-13, 2013
Georgia (Atlanta)
July 15-17, 2013
Mississippi (Flowood)
May 29-31, 2013

College Board AP Calculus AB summer institutes in Georgia:

http://apcentral.collegeboard.com/apc/Pageflows/InstitutesAndWorkshops/showEventList.do;jsessionid=ddbGRFsZd2xppv28vdBJrsnhyw0dyMG8hvKjDlJ5z64QPY7BGy7v!144825576

Title	Start	Last Date to Register	Location
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB - New Teachers	06/03/2013		Woodward Academy (College Park, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB	06/24/2013		Kennesaw State University - ATOMS Center (Kennesaw, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB - New Teachers	06/24/2013		Marist School (Atlanta, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB	07/07/2013		The University of Georgia (Athens, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB	07/08/2013		Kennesaw State University - ATOMS Center (Kennesaw, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB	07/08/2013		Walton High School (Marietta, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB - New Teachers	07/15/2013		Woodward Academy (College Park, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus AB - New Teachers	07/15/2013		Marist School (Atlanta, GA, US)

College Board AP Calculus BC summer institutes in Georgia:

http://apcentral.collegeboard.com/apc/Pageflows/InstitutesAndWorkshops/showEventList.do;jsessionid=ddbGRFsZd2xppv28vdBJrsnhyw0dyMG8hvKjDlJ5z64QPY7BGy7v!144825576

Title	Start	Last Date to Register	Location
AP Summer Institute - Advanced Placement Summer Institute in Calculus BC	06/03/2013		Woodward Academy (College Park, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus BC	07/07/2013		The University of Georgia (Athens, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus BC	07/08/2013		Walton High School (Marietta, GA, US)
AP Summer Institute - Advanced Placement Summer Institute in Calculus BC	07/08/2013		Marist School (Atlanta, GA, US)

The John Neff AP Teaching Award

Nominations are now being accepted for the John Neff Award. This is an award that is usually given annually to recognize the contributions of an AP mathematics teacher in the state of Georgia. The nominee must have taught AP Calculus or AP Statistics or a combination for at least 5 years. Please give a short background or bio/summary of the person you are nominating. I would like to have these nominations by May 31. The qualifications for the award are as follows:

- have taught AP Calculus and/or Statistics for at least five years,
- have contributed to the teaching of AP mathematics beyond their classroom, and
- demonstrates excellent teaching within their classroom.

If you know a teacher deserving of this award, please send your nominations to Debbie Kohler at: adkohlers@yahoo.com.

GA2PMT Wiki
http://gaapmt.wikispaces.com

Go to our wikispace to access our bi-annual newsletters, handouts from Rock Eagle presentations, links to resources, videos of GADOE webinars, and professional development opportunities.

Membership Information

At only $10.00 per year, membership in GA2PMT is probably the most inexpensive professional organization to which you can belong. It only takes a moment to renew and your wallet will scarcely notice the difference; BUT, your school and your students certainly will benefit from the exposure you gain from being a member of this worthwhile organization. Please take a moment to complete the membership form at the end of this issue and bring it with you to the annual meeting or mail it with your ten-dollar check made payable to GA2PMT, to: *GA2PMT ; Storie L. Atkins; Post Office Box 163; Midland, Ga. 31820.*

The benefits of belonging to this organization can make a difference in your students' scores on the AP Exams. The information you get from the readers will help you better prepare your students for the AP Exams.

GA²PMT Membership Form

(Oct. 1, 2013– Sept. 30, 2014)

Name: _____ _____

Preferred Mailing Address: School Home

Name of School:		
Address:		
City, State, Zip:		
Telephone:		Fax:
AP Certification:	Calculus	Statistics
Home Address:		
City, State, Zip:		
Telephone:		
Email:		
Member Status:	New	Renewal

____ I will attend the free luncheon at Rock Eagle on October 16.

Please enclose a check for $10.00 and mail to:
GA²PMT
ATTN: Storie L. Atkins
P.O. Box 163
Midland, GA 31820