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- ✓ GAAPMT at GMC
- ✓ Article: AP Calculus Curriculum Changes
- ✓ Article: Teaching the p-value is not enough
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Letter from the President

"Every child deserves a champion – an adult who will never give up on them, who understands the power of connection and insists that they become the best that they can possibly be." Rita Pierson

Teaching is my passion. It is very important for me to not only impart mathematical or statistical knowledge, but to help students believe in their abilities and never give up. That is very personal to me because as a high school junior, a teacher wrote a note on my report card that forever stood with me in a negative way. She said that I lacked the ability to handle an advanced placement class. I vowed to never be like her. I would encourage students and do my best to help them achieve. Negativism has no place in my classroom and I won't let students say negative things about themselves in my presence. Does that mean I'm an easy teacher? No, I expect a lot, but I support the students in learning.

As I looked for quotes to begin this newsletter, the above quote spoke to me. As a "green" teacher, I wasn't always the best. I was consistent in how I treated students, but I don't think I did the best I could do at encouraging students to do great things---to aspire to make the grade and be the best. It took some years to reach that level. I realized, after many years, that I would never know everything. I had to be a strong, but humble teacher---admitting if I made a mistake, however simple. It made me real to students. I also adopted a personal philosophy---"If you think you know everything there is to know about teaching a specific subject, you need to quit." We can always improve---isn't that what we teach our students? What is your story? It is our goal at GAAPMT to help you be the best teacher you can be, and in turn encourage students toward lofty goals.

If you are receiving this newsletter because it was emailed to you, I encourage you to join our mailing list. This is our 2nd newsletter of the year, but we will have a third one that will be produced in October, 2016. In it you will find a synopsis of all the AP Statistics and AP Calculus questions including common mistakes made by students. We are also publishing articles on our website, www.gaapmt.org. An analysis of one question from the 2016 AP Statistics and AP Calculus Exam can be found on the website, as well as previous years' reading information, newsletters and articles can be found there.

If you would like to receive our newsletter, and you have not signed up, please complete the google form at http://goo.gl/forms/MbQUWbvQ1L . Please feel free to forward this newsletter to colleagues in AP Mathematics! As I said in the first newsletter, we will not share your address with anyone, and will only use it to inform you of newsletters or new articles that have been posted. I organizations or other parties and it will not be sold. The only purpose is to inform you of events related to AP mathematics. We plan to send no more than 1 update per month.

Dr. Debbie M. Kohler

GAAPMT at GMC
October 21, 2016

The Georgia Mathematics Conference at Rock Eagle is fast approaching, and I would like to take this opportunity to encourage each of you to attend. The highlight of the conference for AP teachers is on Friday, October 21 from 8:00 am to 2:00 pm in the Gas Building. Keynote speakers will address topics in AP Calculus and AP Statistics, and there are several sessions for each discipline. These speakers all have extensive experience in the field and are there to bring you best practices and new ideas that will encourage and excite you about teaching AP. My motto as a teacher has always been, "If I think I know it all, I need to quit!" Through 30+ years of teaching, I have always been able to glean wonderful ideas from speakers at this conference dedicated to AP teachers and mathematics teachers. The following grid gives you the schedule for our part of the GMC on Friday.

GAAPMT PROGRAM 2016

	Gas Room 1	Gas Room 2	Gas Room 3
8:00 – 9:15	Sergio Stadler The New AP Calculus Standards & Connections with PreCalculus	Billy Esra Teaching the p-value alone is not enough: p-hacking and pitfalls	Steve Stodgill Nspire your students to mbrace Technology in AP Statistics
9:30 – 10:45	Jeff McCammon Starting Calculus Off Right: A Non-Traditional Approach	Chris Franklin Assessment	Dennis Wilson Setting Bounds – Coping with Approximation Errors in Calculus
11:00 – 12:00	Storie Atkins Using Best Practices in AP Calculus	Debbie Kohler Using Best Practices to Engage Students in AP Statistics	Marshall Ransom Approaching Limits: Visualizing, Calculating, Defining and Using L'Hopital's Rule
12:00 – 12:30	Lunch and Business Meeting		
12:30 – 2:00	AP Calc Reading Report Marshall Ransom & Dennis Wilson	AP Stat Reading Report Billy Esra, Debbie Kohler, & Jean Linner	
2:15	Closing Session for GMC in Auditorium		

I hope you will make plans to attend! Go to www.gctm.org and look for GMC at Rock Eagle to register. Or you may go directly to the site with this link: http://new.gctm-resources.org/gctm/dv7/?q=gmc. Looking forward to seeing you there!

Debbie M. Kohler
President, GAAPMT

AP CALCULUS –AB and BC – CHANGES TAKE EFFECT THIS FALL
Dean Goldgar

As you know, the AP Calculus courses (both AB and BC) are getting a new look for this coming year (2016-17). The traditional acorn book topical course outline has been completely rewritten in a style and using terminology more in keeping with current educational practices, but the substantive changes are relatively few: adding some topics that a great many of us teach in any case and some tweaks to the actual format of the test.

The course descriptions have been rewritten in order to make it clear that the course should focus on the 3 (4 for BC) Big Ideas of Calculus: Limits, Derivatives, Integrals and the Fundamental Theorem, and Series (for BC) with each Big Idea subdivided into enduring understandings. At first it was my opinion that this really just some more education jargon-speak, but as I thought more about it I realized that the new course description has an underlying purpose of presenting Calculus as not really a string of disparate topics and problems but rather a cohesive, interrelated program of study. As teachers, of course, we already know that all the topics are interrelated but the old topical course description was really just presented as a list of stuff for kids to learn. I never really thought too much about it until I realized that a great many of my less able students saw calculus as just that: a series of disjointed topics and problems to solve; they never internalized the unifying concepts of the course.

In addition to the new format of the curriculum we are provided with 6 MPACs, or Mathematical Practices for AP Calculus. It is instructive to really read these 6 MPACs. While there is nothing new in them, the way they are presented does reveal the importance that is placed on them. The first: "Reasoning with definitions and Theorems" indicates that the relatively recent emphasis on testing theorems (usually existence theorems) will not only continue but probably be enhanced. It is pointed out that one should be careful with the conditions of the theorem as well as the general statement. The third MPAC: "Implementing Algebraic/Computational Processes" I think implies that, while no purely pre-calculus questions will be asked, pre-calculus processes are still fair game in moving from the calculus problem to actual answers in the multiple choice sections. No surprise on the sixth MPAC: "Communicating" but it certainly emphasizes the need for students to be able to describe the mathematically what they are doing and interpret correctly what others do. As always students have to be able to clearly put their mathematical reasoning on paper.

Now, let's get down to the nuts and bolts summary of the changes. In AB, L'Hopital's Rule is now included in the curriculum. In BC, the Limit Comparison Test, absolute and conditional convergence, and the Alternating Series Error Bound are all added to the Series unit. What is not clear is whether or not the study of absolute and conditional convergence will include the Rearrangement Theorem. My completely uninformed guess is the Rearrangement Theorem will not be included, but to be safe I will at least touch on it.

Format Changes: The total testing time for the Multiple Choice and Free Response sections is unchanged, but for the Multiple Choice Sections the breakdown is a bit different. The new format will have 15 calculator active questions in 45 minutes and 30 non-calculator questions in 60 minutes. The Free Response remains 2 calculator questions in 30 minutes and 4 non-calculator questions in 60 minutes. Also, of course, there will only be 4 answer choices in the multiple choice sections - which I would assume would move the cut scores upward a few points. Note that new practice exams based on the new format will be released to the audit site during this summer, so be on the lookout for that.

Link to information about AP Calculus AB/BC 2016 curriculum changes:
https://advancesinap.collegeboard.org/stem/calculus

Teaching the p-value alone is not enough: A discussion of p-hacking and other pitfalls of using p-values in research
**Billy W. Esra II**
Math Teacher at Thomasville High School Scholars Academy; Adjunct Professor at Thomas University

According to an article that has shown up in my Facebook feed several times over the last few weeks, "smelling farts may be good for your health" (DeMaria, 2014). After reading the headline, I was skeptical and decided to take the bait and read the linked article which eventually explained that the study referenced actually had nothing to do with farts and long lasting health, but instead with a correlation that was found between the delivery of small amounts of a hydrogen sulfide compound to mitochondria and damage reparation of those cells. To spin the findings into something that people are more likely to click on and read, the news media made the connection between the hydrogen sulfide compound that was used in the study with the hydrogen sulfide compound that is expelled when the human body emits a fart. This article points to several potential pitfalls in scientific research and science reporting. AP Statistics teachers discuss many of these issues when discussing experimental design. We ask students to be critical of reported science and to ask questions of the research process used by the scientists and any assumptions made by non-science periodicals.

Unfortunately, researchers sometimes appear to be using appropriate scientific and statistical methods, while, in fact, they have p-hacked the results to show statistical significance. In order to show statistical significance when performing a significance test, researchers need a p-value that is below the acceptable significance level. A p-value is essentially the probability that a researcher gets the sample outcome that they got or something more extreme, assuming that the null hypothesis is true. If the p-value is less than the significance level (sometimes called the alpha level), then the researcher has statistically significant evidence of a difference from the null hypothesis. For example, my local grocery store is selling five pound bags of peaches. If I gathered a sample of bags of peaches and weighed each bag, the resulting average weight is very likely not going to be exactly five pounds. There is inherent variability in the weight of individual peaches, and the bags cannot be filled to exactly five pounds. We would expect some bags to be a bit heavier and some to be a bit lighter than the grocer claims. If we suspect that the grocer is under filling the bags, we can perform a one sample t-test (a type of significance test) to check this claim. If we get a p-value of 0.013, assuming conditions for inference are met, then if the bags of peaches do have an average weight of five pounds, the probability that we would get the sample average weight that we got or something more extreme is 1.3%, which is not very likely. We might conclude that the bags might not actually be filled with advertised five pounds of peaches.

The significance level is a sort of "line in the sand" where the researcher feels that the results, based on the p-value, are unlikely to have been obtained solely by the inherent randomness of sampling. Traditionally, many fields of science and social science use 0.05 as an accepted significance level, though some fields and publications may require a much more conservative significance level of 0.01 or something smaller. One of the problems with using a significance level of 0.05 is that if the null hypothesis is indeed true, 5% of the samples obtained, or one in 20, will cause the researcher to reject the null hypothesis in error (if the procedure were repeated with the same sample size from the same population). A fantastic webcomic by xkcd.com (Munroe) displays this concept beautifully. After testing 20 different jelly bean colors for a link between jelly beans and acne, the researcher found a statistically significant link between only green jelly beans and acne. Ignoring the fact that no other

color led to a low enough p-value, the newspaper headline warned of a link between green jelly beans and acne. Obviously, the results of the green jelly bean study had a few issues.
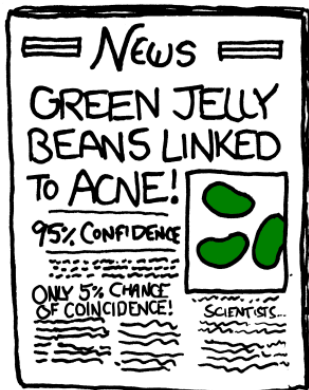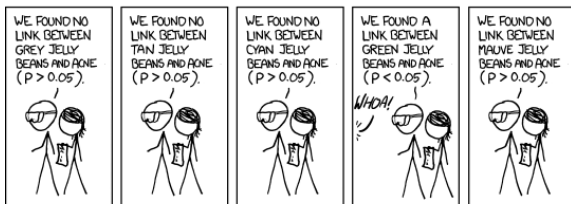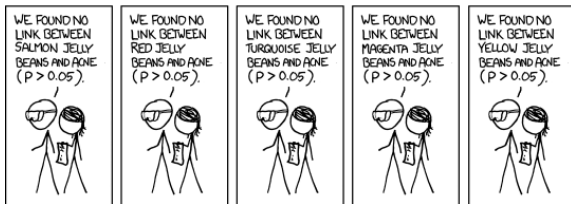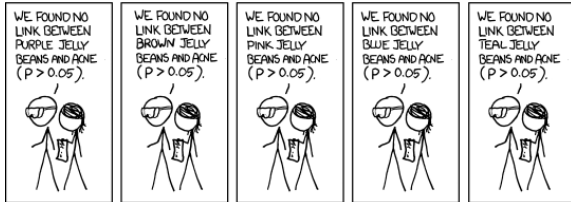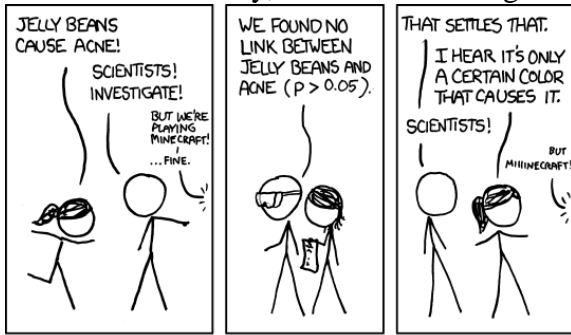
AP Statistics teachers discuss this type of error with our students with the moniker "Type 1 Error," where the null hypothesis is incorrectly rejected. Unfortunately, this type of error is sometimes exploited by researchers. Often in the world of academia, research findings will not be published unless

there is a statistically significant result. According to the old adage, "publish or perish," advancement in degree programs and careers can be stymied without publishable results. Scientific research can be extremely challenging, then, because, often the results are not statistically significant. To find statistically significant results, some researchers have begun to throw as many variables as they can at a research question in order to find at least one variable that shows statistical significance, and is, hence, publishable. This practice of hacking the p-value, or p-hacking, is fairly deplorable from a statistical standpoint, but it often achieves results. For an example of how easy p-hacking can be, check out fivethirtyeight.com's article "Science Isn't Broken" (Aschwanden, 2015). An app available in the article that uses real data can show, with statistical significance, that Republicans in office are bad for the economy or that Republicans in office are good for the economy or that Democrats in office are bad for the economy or that Democrats in office are good for the economy. By controlling which variable(s) are used to measure politicians in office (Presidents, Governors, Senators, and/or Representatives) and which variable(s) are used to measure economic performance (Employment, Inflation, GDP, and/or Stock Prices) you can prove any relationship that you'd like. The practice of p-hacking detracts public confidence from the large quantity of scientists and statisticians that are using inference procedures appropriately. Even, comedian John Oliver, in his show "Last Week Tonight with John Oliver," brought attention to this misuse of statistics in a show on scientific studies (Oliver, 2016). (Warning – John Oliver often uses vulgar language as a part of his comedic news reporting. A PG Version (Oliver, 2016) of the episode was edited by a statistics teacher for use in the classroom.)

P-hacking and other misuses of the p-value led the American Statistical Association (ASA) to release "six principles" of p-values (McCook, 2016) in order to outline the appropriate uses and interpretations of p-values. The actual article written for the ASA can be found on the AMSTAT website (Wasserstein & Lazar, 2016). The ASA feels that people are not purposefully misusing the p-value, but rather that data analysis is not being performed by statisticians who are specifically trained on statistical analysis. Essentially, the p-value should not be the end-all decision maker for whether science is publishable, or important. If statistical significance is found, the researcher should be led to even more questions. Can the results be reproduced, or replicated, in additional studies? (Obtaining funding for replication studies can be difficult.) What is the effect size? (While effect size is not explicitly part of the AP Statistics curriculum, it would be worth discussing with students.) What is the practical importance of the findings? (Just because a study finds statistically significant results, there are no assurances that any practical implications of the findings will be evident.) Ultimately, a low p-value, by itself, should not be used in isolation to display a studies merit. As AP Statistic teachers, we coach our students on how to make an inference decision of rejecting the null hypothesis or failing to reject the null hypothesis based on the p-value. We may do our students, and the future of scientific discovery, a service by spending a little bit of time on how the p-value should be used in research. We should also caution students about practices, like p-hacking, that lower confidence in scientific discoveries and statistical analysis. My hope is that one day, after enough AP Statistics students pass through our classrooms, my social media newsfeed will no longer be filled with studies that link smelling farts to living longer!

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Be sure to check our website, www.gaapmt.org for a preview of the AP Reading Debrief. One question will be posted with reading notes and comments to further explain the grading of the question.

Please check our website for more articles related to AP Statistics and AP Calculus. www.gaapmt.org

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Link to receive newsletter: http://goo.gl/forms/MbQUWbvQ1L

GA^{2}PMT Membership Request

The benefits of belonging to this organization can make a difference in your students' scores on the AP exams.

Becoming a member of a professional organization is one of the indicators listed in the Georgia Teacher Keys Effectiveness System (TKES).

Performance Standard #9- Professionalism and Communication: The teacher exhibits a commitment to professional ethics and the school's mission, participates in professional growth opportunities to support student learning, and contributes to the profession.

To join GA^{2}PMT, you may enter your information online using the following web address: **http://goo.gl/forms/MbQUWbvQ1L** or simply scan the QR code.
You may also complete the information below and mail it in with your membership dues, which are $10 per year.

(Form is on the last page)

GA²PMT Membership Form
(Oct. 1, 2016 – Sept. 30, 2017)

Name:_____

School:_____

Address:_____

City:_____State_____Zip_____

Email:_____

Member Status: New_____   Renewal_____

AP Certification:

☐ **AP Calculus AB**

☐ **AP Calculus BC**

☐ **AP Statistics**

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