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Have you previously received a SURE award? No

If yes, when? N/A

If yes, how did you disseminate results from previous awards (successfully published a paper or obtained a grant, submitted paper or grant based on results, presented results at external conference, etc.):N/A

Student's Name: Holly Hecox

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Have you previously received a SURE award? No

If yes, when? N/A

Proposed SURE Project

Title of proposed SURE project: An Investigation into Data Storage and Analysis Practices at Veterinary Clinics in East Texas

Description of proposed project (describe the scope of the project, including specific objectives):

While the collection, organization and analysis of human patient data in health care research has boomed, structured data analysis from veterinary clinics regarding animal care has lagged behind. This is especially true for clinics in rural areas where costs prohibit investment in discipline specific data storage and analysis software. Even in cases where data is stored using specialized software created for the industry, it often goes without check or analysis due to resource limitations. Thus, the collected animal data rarely informs local veterinarians in such a way to drive decision making.

Concerning the scope of the project, we propose to do the following:

- Survey local vet clinics (~ 4-6) in order to learn how animal data is stored once collected from clients (pet owners). This will be done through face-to-face visits with veterinarians and their staff at local clinics.
- Interview local veterinarians to investigate "what they wish they knew" from the collection of animal data and synthesize responses to detect potential common interests among veterinarians and local clinics.
- Identify which common interests among veterinarians have associated stored data at local clinics that is ripe for mining and/or analysis.
- Analyze the data associated with the common interests among veterinarians and report the results back to the local clinics.

From following these steps, our objectives are to:

- Determine how animal data is stored at local clinics and to investigate whether or not these clinics are aware of modern data collection and storage methods specifically available to vet clinics and animal scientists.
- Identify the level to which local vet clinics use collected animal data to drive decision making.
- Identify common questions that local veterinarians have regarding unmined animal data. In addition to this identification, we will isolate particular questions that have the greatest impact and greatest potential to be quickly addressed (during the time frame allotted for the grant).
- Analyze a series of veterinary clinic derived questions and report answers back to local clinics with two purposes:
 - First, to assist the clinics in learning about their client base through data analysis and
 - Second, to establish a liaison partnership (even if it is just to inform clinics about availability) between local vet clinics and the animal science & statistics research groups at SFA.

Is this a new project or a continuation of a current project? If a continuation, what new work will be done as part of SURE?

The proposed research is a slight continuation of a current project as the first two objectives will be completed during Spring 2019. The third objective is scheduled to begin during the later portion of the Spring and/or earlier part of the summer not covered by the SURE grant. We have already created an (incomplete) list of clinics to contact and we are already familiar with some staff at local clinics. At least two local clinics have staff that are SFA alumni and have already shown the potential to participate. By visiting local clinics during Spring 2019, our intent is to focus work during the summer on actual analysis of data and follow-up communications with veterinarians. We believe this “seeding” of the project in Spring 2019 will best allow us to spend our late summer months engaged in mentoring (faculty to student), learning new statistical techniques required to solve identified problems (faculty to student), and becoming familiar with statistical analysis software (student). See the project timeline below.

Potential impact or significance of research:

The research proposed has the potential to impact local veterinary clinics and their staff, the faculty mentor and student along with the departments they represent.

The research has the potential to impact local vet clinics by providing them with answers to client care issues they previously were unable to answer due to lack of time, staff or expertise in data analysis. Because of this, local animal care quality could increase and/or the ability for the veterinarian to communicate to pet owners can be enhanced due to research findings. Due to our project being “outreach” driven to the community around SFA, the project has the potential to better connect local vet clinics to the animal science and statistics groups at SFA. Such a potential outcome should not be minimized. It is possible that future partnerships between SFA researchers and animal care professionals can be enhanced due to the relationships built during this project.

The research will have a significant impact on the student recipient in several ways. First, the student will see first-hand how interdisciplinary research involving statistical science can impact her chosen career path. We cannot stress enough how much we feel this unique and applied interdisciplinary approach is valuable. The research is entirely hands-on and it will require the student to progress through all phases of the scientific method. The student will directly interact with professionals that work in the very environment she aspires to work in. The student will observe first-hand the interaction between veterinary professionals and a statistical scientist. But this will occur in a unique setting – one in which she and her mentor (the faculty member) will be involved in problem CREATION, analysis and communication of results. Not only will the student get experience in her field, but she will directly see how other sciences (namely, statistical science) synthesize and enhance the understanding of animal care and research. This will not be done in some abstract way. Instead, the student and faculty mentor will be truly both “in the field” and “in the community” – the combination of which is tremendously advantageous for an undergraduate research project that is tangible, interdisciplinary and innately applied in nature.

The research will have a significant impact on the faculty mentor. As an instructor of statistical science classes for animal scientists and pre-veterinary students, he will be able to take the SURE experience (and potentially the data) “back into the classroom” in future years. The faculty member will better understand issues that local animal scientists face and this has the clear potential to shape teaching and communication efforts with future students. Because the research is an outreach to the community, new relationships will be made. These connections have the potential to grow into future consultations for faculty, generate data sets for classroom use, and potentially increase the faculty partnership ACROSS college lines. It is important that CoSM faculty and students become aware of how their disciplines affect those OUTSIDE our college. It is also important for students in disciplines outside the CoSM to see the applicability of mathematics and statistics (and other sciences) in their subject. Again, we suggest this interdisciplinary project coupled with direct community involvement in an applied setting makes this a unique SURE proposal.

Research Design (approach/methodology):

Initially, a list of common interview questions will be created for the participating clinics. Face-to-face meetings will be scheduled with vets at each clinic. The questions will be of three types: a) questions related to data collection at clinics, b) questions related to investigations the veterinarian and their staff may have regarding collected animal data at their respective clinic and c) questions related to how often collected animal data is used to drive decision making at the local clinic.

After answers to the interview questions are reviewed by the mentor and student, two decisions must be made:

1. Which potential investigations mentioned by the veterinarians are common and of appropriate scope to address during the SURE period?
2. What data is available to us (and in what form) for the purpose of addressing such investigations?

At this point in the project, a definitive set of research questions can be relayed back to the staff at the vet clinics and data sets requested. Such data will need to be provided in such a way that removes identifiers of owner/animal names. Additionally, these data sets will need to be cleaned and converted into data sets that can be analyzed in statistical software. These definitive research questions may take the form of hypotheses (requiring inferential statistics techniques) or may indicate the need for some sort of numerical or graphical summary (descriptive statistics techniques) or both.

After the raw data is converted to files used in analysis (data cleaning), the mentor and student will evaluate which inferential and descriptive statistical techniques are best suited for answering each research question formulated from the vet interviews. One-on-one instruction will be provided from the faculty mentor to the student regarding any accessible technique that has not been covered in prior academic classes. In this way, the student will learn new statistical methods in an apprentice style atmosphere.

The student will then analyze the data provided by the clinics using both old methods learned in classes and new ones during the apprenticeship phase. She will construct reports that are for the express purpose of communicating back to the veterinarian at the respective clinics. Potential descriptive statistics methods will include numerical data summaries, contingency table creation, histograms, quantile plots, frequency tabulations, scatterplots, multi-dimensional dot plots and other techniques. Potential inferential techniques include regression and analysis of variance, one, two and multi-dimensional tests of hypotheses contingency table analysis (chi-square methods) and linear modeling along with other procedures. Thus, along with the previously mentioned potential impacts to the student, the possibility of adding to the student's statistical "toolkit" is virtually certain. Using statistical reporting methods taught in classes along with additional writing mentorship provided by the faculty member, reports will be created for the purpose of communicating results to the clinics generating the data.

After closing the loop with the clinics, the student will then summarize all results and experiences into a research poster required from all SURE recipients. She will also give an oral presentation to these recipients as required by the conditions of the grant. Lastly, the possibility of the project being continued or expanded during late 2019 or 2020 (the student's senior year) will be addressed. This includes the possibility of seeking funding from other university sources, the clinics' themselves or other agencies.

Literature review for project (must provide at least five peer-reviewed sources):

The analysis of *large* data sets has already begun to revolutionize how decision making is made for human patients. Within the last decade, big data has offered the potential to create an observational evidence base for clinical questions that would otherwise not be possible and may be especially helpful with issues of generalizability (Murdoch and Detsky, 2013). However, the analysis of large or *small* scale data sets on pet/animal data is not particularly common among rural animal clinics the way that it is for human patients in research hospital settings. However, as outlined in another undergraduate animal science research project at Rutgers University, the innovation of veterinary databases is slowly picking up with the invention of specialized software such as VetCloud (Bargmann, et al., 2016). Bargmann and her students urge veterinarians to make the switch over to electronic health record systems in order to discover epidemiological trends within the data. They argue this has the potential to improve animal healthcare like it has been shown to do for human medicine. Indeed, Etherington (2013) states that such software and record keeping at vet clinics has the potential to "unlock dormant data sitting in vet clinics around the world". Day (2015) echoes these sentiments as they relate to care of larger non-domesticated animals often found in more farming-centric or rural applications of veterinary medicine.

In our SURE project, we are curious to determine if local clinics are aware of these modern data storage mechanisms. Anecdotal investigations suggest they may not be and if they are, they possibly cannot afford their costs. Or, they do not employ enough staff to warrant their use. Large scale data sets and software discussed by Bargmann et al. and Etherington still may not have filtered their way down to widespread use in East Texas vet clinics. In fact, even smaller data sets at rural clinics may go without investigation or have any tangible use. If local clinics are unaware of modern animal data storage and analysis mechanisms, we hope to investigate what type of electronic databases are in fact in use and whether they are ever tapped into for data investigations on animals.

2019 version

Despite many animal data usage trends radiating from larger clinics in larger areas, some basic data analysis techniques stemming from smaller clinics is available in the literature. Experiments such as those done by Godbout et al. (2007) and McLaughlin (2001) are two examples of projects done on dogs brought to small clinics. In one case (Godbout) the research focused on puppy behavior while in the clinic and in another (McLaughlin) the investigation concerned the gait and stride of the animal. Both investigations were motivated from local interests. We surmise that similar research questions have “popped into local veterinarians minds, but we wonder if they are often dismissed due to lack of time or staff to properly analyze data. Or, potentially these investigations are not carried out due to a lack of organization – even electronic storage – of relevant data. Our SURE project seeks to investigate if this is true.

Larson (2016) ends his examination of records kept at vet clinics with this statement: “Veterinarians, in general, often wait for technologies to become so mature before adopting them, they risk society moving past that technology and onto something new”. We wonder if this is true locally. Indeed, if in larger areas of practice, vets have been slow to implement new record keeping techniques that make statistical mining and analysis next to impossible, then what might the state be of smaller rural clinics with lesser resources? Their location and stature alone may not diminish the opportunity for animal data driven investigations. We hope to make a dent locally in this potential problem by offering our availability and expertise through this SURE project.

Bargmann, Samantha; Long, Mary; Kerner, Jaclyn and Fagan, Julie (2016). *Big Data Can be Expected to Advance Veterinary Medicine*. Rutgers University Libraries Community Repository. Available at <https://rucore.libraries.rutgers.edu/rutgers-lib/51566/>

Day, Cheryl. (2015). *Turning to Big Data to Manage Animal Health*. National Hog Farmer. November 2015.

Etherington, Darrell. (2013). *VetCloud Hopes to Unlock the Dormant Data in Veterinary Clinics Around the World*. TechCrunch, September 2013.

Godbout, Martin; Palestini, Clara; Beauchamp, Guy and Frank, Diane (2007). *Puppy Behavior at the Veterinary Clinic: A Pilot Study*. Journal of Veterinary Behavior, Volume 2, Issue 4. pp. 126-135.

Larson, Eli (2006). *Could Patient Care Apps and Open Records Work for Your Veterinary Practice?* Veterinary Informatics in General Practice, pp. 710-712. Available at http://www.fetchdvm360.com/wp-content/uploads/2016/08/CVCKC-2016-706-721-veterinary_informatics_in_general_practice.pdf

McLaughlin, Ron. (2001). *Kinetic and Kinematic Gait Analysis in Dogs*. Veterinary Clinics: Small Animal Practice, Volume 31, Issue 1. pp. 193-201.

Murdoch, Travis and Detsky, Allen. (2013). *The Inevitable Application of Big Data to Health Care*. Journal of the American Medical Association Network. Volume 309, Issue 13. pp. 1351-1352.

Project timeline (activity/task and time to complete):

- November 2018
 - Activity: Construct initial list of potential clinics to approach about inclusion in project.
 - Time to Complete: Done. [With the help of Dr. Joey Bray, chair of the Department of Agriculture]. Two clinics have agreed in principal to participate already.
- December 2018 – January 2019
 - Activity: Write SURE Proposal
 - Time to Complete: Done
- March 2019
 - Activities: Finalize list of potential clinics for inclusion in project. Contact each potential clinic and determine their final interest in participation. Schedule interviews with veterinarians at clinics making final participant list.
 - Time to Complete: One Month
- April – May 2019
 - Activities: Interview veterinarians and compose a list of potential investigations and data sources at each clinic Synthesize what is learned from each clinic and determine final data sources and list of common topics to investigate based on available information.
 - Time to Complete: Two months
- June 2019
 - Activities: Retrieve and clean data from clinic sources. Construct data sets for analysis.
 - Time to Complete: One month. This will be done while the student is away from Nacogdoches and will be done via email sharing of files between the faculty mentor and the student both of which will be involved in the

effort. The student has agreed to arrive back in Nacogdoches for SURE grant period preparation on July 1, 2019.

- July 1 – July 26, 2019
 - Activities: Analysis of Data. This is the "apprenticeship" period between the faculty mentor and student regarding any new statistical methodology that needs to be taught. SURE Grant period begins July 16. Meetings with other SURE recipients begin. Schedule meetings with participating vet clinics regarding final conclusions from data analysis.
 - Time to Complete: Four weeks of data analysis "boot camp" between mentor and student along with investigations into necessary statistical software.
- July 29 – August 2, 2019
 - Activities: Report writing for the purpose of communicating back to participating clinics. Initial meetings with vets to discuss results. Meetings with other SURE recipients continue.
 - Time to Complete: One week plus parts of prior "apprenticeship" weeks as they allow based on completed analysis. In all, the report writing is expected to span multiple weeks culminating in this final writing intensive week.
- August 5 – August 16, 2019
 - Activities: Additional meetings with vets to discuss results (those not scheduled in the week prior), construction of final research poster as deliverable of the SURE grant, slight adaptation (if necessary) of report to clinics to serve as the summary report as required by SURE grant, meeting with other SURE recipients continue. Student presentation of results. SURE grant period ends August 16.
 - Time to Complete: Two Weeks.

Description of research and professional skills that the student will develop from the project:

The following is a list of skills the SURE grant will target for development in the student:

- Interviewing and listening to a potential client and communicating effectively with a practitioner in the field. This involves proper personal presentation in terms of speech, body language and dress.
- Assimilating notes taken from meetings in order to construct common themes available for investigation.
- The CONSTRUCTION of research questions based upon the needs of a client and the ability to ascertain what data is available to directly aid in the answering of the constructed questions.
- The ability to create a data analysis "road map" that includes the following: the research question, hypotheses, data available, the method best judged to analyze data.
- The appreciation for the time needed to "clean" research data and prepare it for analysis.
- Additional data analysis skills acquired through apprenticeship with statistics faculty mentor.
- Additional statistical computing skills acquired on a need-to-know basis during the analysis phase of a statistical research project.
- Writing effectively to multiple audiences: client (vets at clinics), students involved in similar projects in other disciplines (other SURE grant recipients) and established researchers in other fields (faculty)
- Speaking effectively to multiple audiences
- Managing time required for research effectively. Learning to know "what to let go" and "what to pursue" in order to complete a research project in a timely manner.
- Networking with veterinarians in the area in order to establish contacts for future research, work or recommendations.

Description of the involvement and activities that the student and mentoring faculty will have in this project

The following is a list of ways in which the mentoring faculty member and student recipient will work together:

The faculty member will mentor the student by:

- Coaching the student on how to construct a list of questions for a client.
- Discussing the importance of effective speech, eye contact, body language and genuine listening and note taking while with clients.

- The importance of “following-up”, thanking and keeping an open line of communication with clients and research partners.
- Counseling the student on how good research questions can be formulated based on information from multiple sources
- Directing the student through each stage of the scientific method including: making and gathering observations, constructing questions, formulating hypotheses, making and testing the predictions or expected outcomes as communicated from the clients, and then using conclusions to reformulate possible new inquiries.
- Teaching the student data cleaning methods and what to look for in raw data as opposed to “textbook” data.
- Teaching the student new statistical methodology in a one-on-one setting as necessary.
- Editing the scientific reports generated by the student.
- Counseling the student on difficult choices that must be made in regards to time management in research.
- Leaving time for non-direct work conversations. Letting their be time for casual, yet professional, exchanges of non-grant related conversations so as to convey the balance any researcher needs to have between his/her work and their family, hobbies or additional interests.

Description of how you will disseminate results from the project:

The student will construct brief reports to share with the veterinarians at the participating clinics. These reports will provide a synopsis of the methodology and conclusions obtained regarding the questions the vets themselves had a hand in creating. The student will also present her research orally to the other recipients at the end of the SURE period and create a research poster. Opportunities to present the poster or a modified version of the poster at other undergraduate research “days” or conferences both at SFA and elsewhere will be explored. While it is not known whether or not the results will merit a professional publication, this option will be explored and the process by which this is done will be discussed with the student. If the research continues (and is funded) beyond the life of the SURE grant in some fashion, then the creation of such a publication would/should become a more reasonable objective/goal.

The results of this project will also be disseminated by the faculty mentor in subsequent semesters to other students enrolling in STA 320A: Statistical Methods for the Animal Sciences. Such communication will at least serve to underscore the interdisciplinary relationship between the statistical and animal sciences. Moreover, it may motivate additional honors contracts (the student applicant here being an example), additional SURE grant applications or additional joint undergraduate research projects of other kinds.

Budget (\$0-\$500 with justification):

The applicants request no supply budget.

However, the faculty mentor wishes the review committee to strongly consider the possibility of the double matching funds requested below for the student scholarship. Each department has agreed in principle (i.e., pending available funds during Summer 2019) to invest an additional \$500 toward the student. It has been a continual research initiative at SFA to foster interdisciplinary collaboration across departmental AND college lines. This SURE proposal is keenly positioned to do this. While some of the proposals you will review will involve one department from the CoSM, please consider the uniqueness of each department represented here to individually contribute to the student scholarship.

While we recognize such double matching is not appropriate for the faculty mentor, notice that each department has agreed to consider JOINTLY funding the faculty stipend match. Again, this may be unique among your applicant pool. We ask you to consider this as both a good-faith effort to join forces across college lines and to see this approach as creative and innovative.

Amount requested for supplies from SURE: \$0

Amount requested for supplies from department: \$0

- ❖ **Amount department will fund faculty stipend: Each department (pending available summer funding) may contribute up to \$650 in matching funds to add to the \$1300 faculty stipend (for a total not exceeding \$2600)**
- ❖ **Amount department will fund student stipend: \$500 PER DEPARTMENT for a total of a \$1500 scholarship applied to the student’s Fall 2019 tuition bill.**

Chair approval (Mathematics & Statistics)

Lisa Buerf Chair Signature

- ❖ Dr. Joey Bray, Chair of the Department of Agriculture, has agreed to provide a memo if the committee so desires indicating his willingness to support the involved faculty and student in the above outlined manner. He may be contacted at jbray@sfasu.edu.

I have reviewed and agree to fulfill the expectations of the SURE award.

Holly Kase
Student Signature

Agustin
Faculty Signature

For internal purposes only:

Proposal Awarded _____ Proposal not award _____ Amount awarded: _____

Accounts to be used for award: _____

If funded, the
dept. is willing to
support \$500 for the
student. I do not
expect to have
matching funds
for salary of faculty.
AB