

## TIGURS 2024 Projects

The TIGURS program offers a wide range of potential projects. In the Table of Contents below each project title, faculty member, and department is listed. A longer description can be found by clicking on the project title, which will link to a paragraph long description of the project. Students are encouraged to select projects from this list for their application form. In the form students will be able to indicate interest in multiple projects. For students who are interested in other potential fields not listed here for projects please contact the Office of Undergraduate Research and Creative Inquiry [ourci@towson.edu](mailto:ourci@towson.edu). Students are encouraged to reach out to faculty on the email listed in the project description with any questions.

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## Full Project Descriptions

### College of Business and Economics

#### Using time-series macroeconomic data in excel for economics policy

Dr. Shantanu Bagchi ([sbagchi@towson.edu](mailto:sbagchi@towson.edu))

I am proposing an applied macroeconomics-focused workshop for the Summer 2024 cohort of the TIGURS program. The goal of this workshop is to introduce freshman students to macroeconomic measurement in general, and to the trend and business cycle components of time-series macroeconomic data in particular. A key priority of the Congress and the Federal Reserve is economic stabilization, i.e. preventing a persistent downturn in economic activity, while also encouraging long-term growth. This workshop will introduce students to the empirical elements underlying such policy-making processes, while building a solid foundation in Microsoft Excel. The skills that students will learn in this workshop will be invaluable for the job market, especially in industries related to the data sciences, such as Economics, Finance, and Business.

#### The role of AI in sustainable development or lack thereof

Dr. Nhung Hendy ([nhendy@towson.edu](mailto:nhendy@towson.edu))

My research interests are in the area of human resource management and sustainability. I am currently mentoring an undergraduate student in examining the role of generative artificial intelligence (AI) in higher education from the perspective of students and faculty. My plan is to conduct another research study looking at the role of AI in sustainable development or lack thereof. I have also published articles in which I proposed a conceptual model to foster undergraduate

student intellectual humility through the use of technology delivered instruction. This conceptual model needs to be validated with data that I hope will stimulate student interest.

## College of Education

### **Autoethnographic methods to comprehend and promote culturally responsive education**

**Dr. Deneen Dixon-Payne (ddixonpayne@towson.edu)**

Research Proposal: This undergraduate research experience aims to investigate the pivotal role of qualitative research, particularly employing autoethnographic methods, in comprehending and promoting Culturally Responsive Education within the realm of education. The primary focus of the study will be on Culturally Responsive Education, which actively recognizes and values cultural diversity within educational settings. By initiating the research process with self-reflection and analysis of personal experiences within a cultural context, the study aims to cultivate a foundation for becoming culturally relevant and responsive educators.

### **Positive psychology interventions to improve learners' overall well-being**

**Dr. Suzhen Duan (sduan@towson.edu)**

Dr. Suzhen Duan's research interests focus on motivation, specifically applying one of the most widely used positive psychology interventions—Best Possible Self (BPS)—in real-world educational contexts to improve learners' overall well-being, attitudes, academic commitment, and professional identity. She conducted studies among pre-service teachers, graduate students, novice instructional designers, children, and faculty members. The potential projects you might want to work on with her include 1). A program design for children in grades 1-3 titled "Elevating Multilingual Learners' Happiness and Success: A Robotics-Infused Journey to Flourishing." 2). A quantitative study focusing on graduate students' well-being changes from the early stage of the pandemic to post-pandemic. 3). A qualitative study focusing on novice instructional designers' identity. 4). Computing graduate students' perceptions to a Best Possible Self-reflection intervention: A multiple case study.

## **Design thinking to solve real world problems**

**Dr. Liyan Song (lsong@towson.edu)**

I would like to work with a group of 4-5 students to engage in research on the application of design thinking to solve real-world problems. As a process of problem solving, Design Thinking has been applied across various disciplines to help engage students in developing creative and innovative solutions to open societal problems. Students from all disciplines are welcome to join this research team. I will first introduce the Design Thinking framework to the students and work with the students in identifying a real-world problem and developing a solution to the problem by applying the design thinking framework. Students will be asked to document their design experiences, which will become part of the data sources for the research project. I plan to work with the students in preparing a research report based on their design experiences and submit it for conference presentation and journal publication.

## **Immersive virtual reality learning environment impacts on psychomotor learning outcomes**

**Dr. Mahnaz Moallem (mmoallem@towson.edu)**

Exploring the Impact of an Immersive Virtual Reality (I-VR) Learning Environment on Cognitive, Affective, and Psychomotor Learning Outcomes” is a broad research study. It covers developing immersive virtual reality content using the Unity engine for various subject matters and learners and/or studying the impact of I-VR on cognitive, affective, or psychomotor learning. The primary focus will be on using head-mounted displays that allow students to explore complex subjects in a way that traditional learning and training methods cannot. Students who join this research study and are interested in working with the researchers to design and develop immersive virtual reality content will be given access to a series of basic and advanced training offered by Unity Academic Alliances to obtain credentials and build knowledge and skills. The Unity training is available for the project participants for free. Those students who are only interested in conducting research given already available content could also work with the researcher to design and implement a study focusing on cognitive, affective, or psychomotor learning outcomes.

## **Enhancing Diversity, Equity, and Inclusion (DEI) in teacher education through interactive simulations**

**Dr. Hoda Harati (hharati@towson.edu)**

My research focuses on enhancing Diversity, Equity, and Inclusion (DEI) in teacher education through interactive simulations. A potential project for students involves working on DEI-based simulations that address real-world classroom situations. Students would assist in implementing these simulations, gather and analyze data, and contribute to developing teaching materials. This project aims to improve teacher preparedness in diverse educational settings, making a significant contribution to innovative, inclusive teaching practices.

## **Mixed methods for use in program evaluation in education**

**Dr. Gregory Knollman (gknollman@towson.edu)**

I have worked with undergraduate students within the College of Education over the past several years as a mentor for both URCI undergraduate projects and COE undergraduate projects. My work has involved guiding students through the process of conducting a systematic literature review, considerations for general survey design, and deployment of mixed methods for use in program evaluation. Prior work included connecting with colleagues at other institutions who shared information on the deployment of research methods within educational research and program evaluation specific to the social sciences, and more specifically educational research. I have an ongoing project that specifically examines the used of person centered approaches to individualized educational programming and transition planning for youth with disabilities and their families. I will continue this work this summer, specifically developing a small evaluation of personnel around the state of Maryland who have participated in capacity building seminars to deploy specific person centered practices with education programming for youth and young adults with disabilities and their families. Certainly, I would be open to working with students on this specific project that will include a review of literature on person centered practices, deployment of mixed methods to gather input from educators and families using person centered practices and sharing results with individuals at the state and national level who are specifically working on this particular area of practice. Those not interested in this specific research, could still gain valuable information from weekly seminars that would include workshops specific to conducting systematic literature reviews, developing survey instruments and semi-structured interview protocols, and completing descriptive statistics and thematic analysis of program evaluation data as a connection to research evaluation designs. Additionally, they would still be invited to participate in the weekly conversations with colleagues

across institutions that are conducting research or serving in a role across a research to practice pipeline. Guest speakers in the past have varied from directors of family support within the Maryland Development Disabilities Agency, to faculty from Duquesne, University of Missouri Kansas City, and personnel at research non-profits like the American Institute for Research (AIR). I would envision offering something similar again this year, inviting colleagues from state or federal agencies, community non-profits, and university faculty to offer input on how they think about the research to practice process, both specific to the work that I am collaborating on, as well as to the broader implications for the research to practice pipeline critical to the advancement of knowledge across education and social sciences.

## College of Fine Arts and Communication

### Special effects and Industry Studies of film with applications to aesthetic/representational questions

**Dr. Michael Duffy (mduffy@towson.edu)**

I am a Film and Media Studies Scholar that concentrates in the areas of Special Effects and Industry Studies. I regularly teach classes in the Electronic Media and Film Department on Introductions to Media Studies, Film History, Gender/Representation in Film, Critical Genre Studies (Disaster Films, Vampire Films, Superhero Films, Provocative Films), and International Cinemas such as Post-War Japanese Film and Chinese/Hong Kong Film. In past years, I have mentored students in Directed Studies on projects surrounding South Korean Cinema, Black Film History, Orson Welles, and Gender Representation in Film History. I am open to mentoring EMF or non-EMF majors on research projects related to Film and Media History and of course contemporary debates on industrial/aesthetic/representational questions.

## **Social media as empowerment tools with applications to sexual violence or political journalism**

**Dr. Pallavi Guha (pguha@towson.edu)**

My primary research focuses on sexual violence and social media as empowerment tools, and my secondary research focuses on gender and political journalism. I have two projects I am working on and could work with students on either: 1.

Parental awareness of teenage girls of color on sexual harassment on social media platforms: This study will explore how parents of teenage girls of color use online communities and platforms to create awareness of online sexual harassment. Parents are increasingly finding it difficult to have a conversation about social media sexual harassment with teenagers due to a lack of resources. In early 2023, social media platforms such as Snapchat and TikTok shared infographics on privacy and security as resources for parents; however, there is limited awareness among parents. To collect data for this study, I will use a two-pronged approach, semi-structured interviews with parents of teenagers and analyzing videos and comments from YouTube Channels for parents on safety training, such as Cyber Fareedah. 2.

Online news and information engagement of South Asian American female voters in the upcoming 2024 U.S. Presidential Elections: This study will explore how South Asian American female voters plan to engage with the news during the 2024 Presidential election news cycle. This project focuses on understudied but critical demography at the intersection of political journalism, the issues that matter to the community, how they see themselves being portrayed in the media, and where they seek information and engage online. To collect data for this study, I will use semi-structured interviews with South Asian American female voters.

## **College of Health Professions**

### **The cultural phenomenon that is competitive junior golf**

**Dr. Ryan King-White (rwhite@towson.edu)**

I primarily conduct research using qualitative methodology (genealogy/history; ethnography; critical media literacy; observation; interview), and am currently focused on gaining a better understanding the cultural phenomenon that is competitive junior golf. This is a continuation of the work that I was doing last summer, and will contribute to a book on the topic. Essentially, student(s) will accompany me to junior golf events in the summer (1-2 day tournaments on weekdays and weekends) to provide further observations and assist in recruiting interview participants. Contact hours for this type of research are pretty intensive on

tournament days and then we will reflect on our observations upon return. Also, interviews will be conducted on zoom and recorded for the student to get experience with transcribing.

## College of Liberal Arts

### Using AI to empower students' learning and address issues of inequality and injustice

**Dr. Jianfen Chen (jianfenchen@towson.edu)**

Are you interested in how we can collaboratively and creatively use AI, empowering students' learning and addressing issues of inequality and injustice in the learning experience? If so, I invite you to join me in an exciting research project centered on students' experiences and perspectives on the integration of AI tools, particularly ChatGPT, in teaching and learning. To ensure that students are at the center of college education, we assert that their views and concerns about incorporating ChatGPT into teaching and learning should be heard. As educators and scholars at Towson, we have been actively exploring and experimenting with AI tools since their debut, recognizing their potential to both enhance learning and pose challenges such as academic dishonesty. Acknowledging the double-edged nature of these tools, we believe there is a need for creative and ethical solutions for their incorporation into teaching and learning practices. This research project seeks to understand students' views, experiences, and concerns about using AI tools through surveys and one-on-one interviews. The key research questions include how you would like instructors to use ChatGPT, your expectations for the language of AI in syllabi, preferences for AI tools to support learning, perceptions of unethical AI use, attitudes toward AI tools in learning, and experiences with their integration. This research, centered on students' experiences, is significant in providing timely, valuable insights for instructors to redesign teaching methods, assignments, and syllabi language.

## **Unearthing TU's history project**

**Dr. Christian Koot (ckoot@towson.edu)**

Interested in learning more about Towson University's history of diversity, student organizing and protest? Then consider joining the Unearthing TU's History Project. Student research assistants will work with and under the mentorship of a team consisting of the Assistant University Librarian for Special Collections and University Archives and the Chair of the Department of History. The Unearthing Towson's History Project is an interdisciplinary collaborative effort that centers students as researchers and interpreters and connects alumni and the wider community to the university. Projects will include recording interviews with alumni, conducting archival research into Towson University's history, and sharing a more diverse history with the Towson community.

## **Promoting equitable education practices for Black students, families, and communities**

**Dr. Shanye Phillips (saphillips@towson.edu)**

Broadly speaking, I am interested in promoting equitable education practices for Black students, families, and communities. An upcoming project will be examining experiences of special education through the lens of Black college students who were previously identified as having an educational disability (k-12). In the spring, students within the research lab will be completing a literature review and examining existing research on the topic. During the summer students will continue ongoing research efforts within the existing research lab project. Student will support in examining existing literature on the topic and begin considering methods for data collection. As this project is part of an existing research lab, if interested in the fall once classes resume data collection via focus groups and interviews can begin.

## **Interventions to support the wellness of survivors of trauma with a focus on the Black community**

**Dr. Pearis Jean (pearisjean@towson.edu)**

Are you interested in Black wellness and supporting survivors of trauma? I conduct research on the development of individual and community-level interventions to support the wellness of survivors of trauma with a focus on the Black community. Dr. Shanye Phillips and I lead an interdisciplinary research lab called the R.E.G.A.L. (Research Empowering Growth-Oriented Afrocentric Liberation) Collective that broadly focuses on Black wellness from a counseling psychology and school psychology perspective. In the spring, I am starting a project focused on identifying the specific challenges that Black survivors of interpersonal violence face as they navigate their life post-incident and their healing journey. During the summer, students will continue the ongoing research efforts by examining existing literature on the topic and aiding in the development of the survey for the project. Students will have the opportunity to learn about survey development, Black feminist research ethics, and building credibility and trustworthiness with the Black survivor community. I am also open and excited to support students who have other project ideas related to Black wellness.

## **Fisher College of Science and Mathematics**

### **How E. coli can block immune response in the social amoeba and flatworm**

**Dr. Michelle Snyder (msnyder@towson.edu)**

My lab uses simple model organisms to study host-pathogen interactions. Current ongoing work in the lab centers around a protein expressed by uropathogenic E. coli called TcpC. TcpC is what we call a virulence factor that causes bacteria to be more infectious. TcpC appears to cause virulence by blocking host immune responses. To study the ways that TcpC blocks immune response, we are focusing on two model host organisms—the social amoeba *Dictyostelium discoideum* and the planarian flatworm. Both of these organisms are relatively easy to work with so tend to be good models for students to use for experiments. A few possible projects over the summer, depending on student interest, include: 1) determining what types of stimuli cause TcpC to be expressed (ie, turned on) in bacteria. This project would involve bacterial culture, gel electrophoresis and western blots; 2) working with mutant strains of

Dictyostelium discoideum to see what genes in this host are affected by TcpC. This project involves bacterial and eukaryotic cell culture, and could involve PCR-based methods; 3) expressing large amounts of TcpC or other related proteins in bacteria so the proteins can be used for enzymatic or structural studies. This project involves protein expression and protein purification, using biochemical techniques like affinity chromatography.

### **Behaviors and mechanisms of fluorescent nanoparticles with applications in drug delivery**

**Dr. Khanh-Hoa Tran-Ba (ktranba@towson.edu)**

The interdisciplinary and externally funded research in the Tran-Ba Laboratory at TU is focused on studying the diffusion dynamics, behaviors, and mechanisms of individual fluorescent nanoparticles (5 to 200 nm in diameter) by tracking the diffusion of the particles on a state-of-the-art fluorescence microscope. The research findings gained in these projects will allow us to better understand the microscopic properties of the studied complex soft materials including microporous hydrogels. The deeper understanding gained through this work will help us to better utilize the material in technological applications such as drug delivery. One of the Tran-Ba lab current research efforts involves the microscopic characterization of the evolving hydrogel structure during photo-crosslinking of the polymer precursor solution. After joining our lab, the participating student will be trained on various research aspects including learning to properly prepare polymer samples, imaging the as-prepared samples on our super-resolution fluorescence microscope, and analyzing the collected video data using quantitative data analysis methods and computer routines.

### **Data science and health monitoring with applications to exercise science**

**Dr. Woosub Jung (woosubjung@towson.edu)**

My research spans various domains within the intersection of computer science and healthcare. My recent work demonstrates a strong commitment to addressing real-world health challenges through the application of cutting-edge technologies like supervised learning models for health monitoring. A potential project involves reproducing observations from the athletic-focused research project 'LAX-Score' and integrating them into a practical web system. This approach enables students to not

only gain proficiency in data science skills but also cultivate hands-on experience in the field. Preferred candidates are those pursuing a double major in computer science and exercise sciences.

## **Authorship verification with Large Language Models (LLM)**

**Dr. Qingqing Li (qingqingli@towson.edu)**

Authorship Verification with Large Language Models Introduction: Authorship verification, the process of determining whether a given text was written by a specific author, is a critical task with applications in forensic linguistics, cybersecurity, plagiarism detection, and beyond. Traditional authorship verification methods involving Nature Language Processing (NLP) have relied on linguistic and stylometric analyses to identify unique writing patterns associated with individual authors. While traditional methods have proven effective, they come with certain challenges such as linguistic features (word usage, sentence structure, and punctuation) limitation may result in insufficient discrimination power, authors deliberately alter their writing style or adopt a broader vocabulary may result in a less consistent linguistic profile, and, limited access to comprehensive and diverse datasets for training and testing and so on. Large Language Models (LLMs), exemplified by models like OpenAI's GPT (Generative Pre-trained Transformer), Meta's LLaMA, and Google's BARD are well-suited for authorship verification due to their advanced language understanding and generation capabilities. These models undergo pre-training on vast amounts of diverse text data, enabling them to grasp intricate linguistic patterns, vocabulary nuances, and diverse writing styles. The training process equips LLMs with a profound understanding of context, allowing them to capture the subtleties of author-specific writing behaviors. Leveraging transfer learning, these models can be fine-tuned on smaller datasets for authorship verification tasks, adapting to the unique characteristics of individual writing styles. Their versatility, ability to handle varied genres, and proficiency in detecting anomalies make LLMs a powerful tool for distinguishing and verifying authors based on their linguistic fingerprints, contributing to the field of forensic linguistics and cybersecurity. Methodology: Data: PAN Authorship Attribution Corpus is a public dataset designed for authorship attribution, which can be relevant for understanding individual writing styles. Students will learn basic data processing techniques such as data cleaning, encoding, text preprocessing, ect. These basic data processing techniques are fundamental to preparing data for analysis, modeling, and machine learning tasks. Large language model selection: to reduce the dataset size requirements, we'll utilize a pre-trained model for the authorship verification that involves fine-tuning a pre-trained model

on a dataset specific to the authorship verification. Choosing the right pre-trained LLM involves a balance between model capabilities, computational resources, and task-specific requirements. Students will learn two or three LLMs including model architecture, model size, training objectives, and specific design features to decide which LLM is good for the authorship verification. Model architecture adjustment and update: Depending on the LLM architecture and verification performance, architecture adjustment and updates may be needed to match the specific requirements of the authorship verification task recursively. For instance, you might add a classification layer for identifying authors, and update the model's weights after fine-tuning. Students will learn how to fine-tune methods and other model layers. Perform evaluating experiments: Basic concepts related to machine learning evaluating experiments such as train-test dataset split, loss function, cross-validation, performance metrics, and optimization will be introduced to students. In this step students will learn how to design and implement evaluation experiments including model training, validation and hyperparameter tuning, and evaluating the trained model on a separate test dataset to assess its performance in authorship verification. Final report: This project will require a final report that records the project methodology. Summa

## **Information technology, machine learning, cybersecurity, and networked infrastructure**

**Dr. Wassila Lalouani (wlalouani@towson.edu)**

My research interest lies in the intersection of information technology, machine learning, cybersecurity, and the evolving landscape of networked infrastructure. As modern societies heavily rely on digitalization, incorporating networked systems, cloud services, IoT and cyber-physical technologies, the need for robust cybersecurity measures becomes paramount. However, the increasing reliance on computational and storage platforms, coupled with advancements in artificial intelligence, has also attracted cyber-criminals, leading to sophisticated attacks. Notable instances include the deployment of malicious command and control servers on cloud platforms, malware targeting different systems, and cyber-physical system attacks. In my research, I aim to enhance cyber defense strategies by gaining a comprehensive understanding of different cyberattacks across different protocol and application levels. Specifically, I focus on contributing to the development of effective countermeasures for strategic applications like autonomous driving cars, health systems, and safeguarding digital ecosystems from emergent cyber threats.

## **The Internet of Things and mobile app development**

**Dr. Akshita Maradapu Vera Venkata Sai**

**(amaradapuveravenkatasai@towson.edu)**

My research focuses on different aspects of Internet of Things (IoT) like Edge computing, digital twin networks and devising mechanisms that aid in promoting user privacy in these different IoT applications. The goal of the project I have is to introduce the concept of Internet of Things (IoT) to the students. IoT data is very valuable and can provide a lot of information about the users like the activity on their smart devices and reveal sensitive information with data analysis and machine learning. IoT data usually comprises of data obtained from different sensors present on these devices. For example, our phones are equipped with sensors like accelerometer, gyroscope, magnetometer, light and pressure sensors and GPS. Information obtained from these can be used to extract information like phone passcodes, typing patterns, location patterns and many more. In this project, we will do something similar, by creating a mobile application that can access the data from these different sensors and then analyze the collected data to identify usage patterns associated with the different applications users interact with on the foreground. Apart from understanding the sensor data, the students will also get to work on mobile application development, which could be a skill that will help them in the future as well.

## **Samples/device fabrication, optical, cryogenic, and magnetic materials characterization techniques**

**Dr. Vera Smolyaninova (vsmolyaninova@towson.edu)**

The area of my research interest can be described broadly as novel materials. In particular, I am interested in metamaterials, materials which properties cannot be found in nature. Metamaterials have building blocks larger than atoms, and properties of these building blocks can be designed at will. We use metamaterial approach to engineer the properties of different materials. For example, we have shown that metamaterial engineering could increase the critical temperature of superconductors. Superconductors are materials, where the electric charges are flowing freely, without dissipation, at the temperatures below critical temperatures, which are typically very low. For potential applications, such as lossless power transmission, MRI magnets, maglev trains, or computing, increasing this critical temperature is crucial. There are also other research directions related to novel materials which we are working on in my lab. My students learn different

samples/device fabrication techniques and optical, cryogenic, and magnetic materials characterization techniques using state of the art new instruments recently set up in the Science Complex.

## **Experimental materials physics with thin films**

**Dr. Rajeswari Kolagani (rkolagani@towson.edu)**

My research is in the field of experimental materials physics with a focus on electronic materials that have many technological applications including sensor technologies, clean energy/ renewable energy applications and information storage. I have been involving undergraduate students in my research for many years, and I expect to have projects for undergraduate students in summer'24. The student projects will be linked to one or more of our ongoing research projects related to thin films and multi-layers of materials such as Strontium Titanate and Calcium Manganese Oxide. "Thin Films" are nanoscale forms of these materials that we fabricate in our laboratory using a technique called Pulsed Laser Deposition (PLD). We study the properties of these thin films employing analytical tools such as x-ray diffraction and electrical transport measurements. Using information from such studies coupled with several 'in-situ' analytical techniques available on the Pulsed Laser Deposition system, we optimize the deposition parameters to engineer material properties desirable for technological applications. Participation in these research projects does not require any specialized knowledge or prior laboratory experience. However, it is important that students have a strong motivation for research as well as interest and ability to do hands-on work in the laboratory. Students will be provided with learning resources and training in laboratory techniques. Teamwork is highly emphasized in my laboratory so willingness to work in collaboration with others is also required. Materials Physics is an interdisciplinary field that bridges several disciplines including physics, engineering, and chemistry. Research experience in my laboratory will help student gain several 'transferable' skills that are valued both in industry and academic research in multiple disciplines.