M*A*T*H COLLOQUIUM

Spring 2025 102nd LECTURE SERIES

Sonoma State University Department of Mathematics & Statistics presents a series of informal talks open to the public

1/29/25

THE PERCEPTION OF PICTURES; PERSPECTIVE PROJECTION, NMERICAL APERTURES, & BAYESIAN INFERENCE - MARTY BANKS, UC BERKELEY

PICTURES—PHOTOGRAPHS, PAINTINGS, COMPUTER-GRAPHICS IMAGES—ARE USED UBIQUITOUSLY IN OUR SOCIETY. PHOTOGRAPHERS AND ENGINEERS HAVE RULES OF THUMB FOR CREATING DESIRED PICTORIAL EFFECTS. TO UNDERSTAND THESE RULES WE NEED TO GO THROUGH THE GEOMETRY OF PERSPECTIVE PROJECTION AND OF IMAGE FORMATION BY CAMERAS. WE ALSO NEED TO INCORPORATE BAYESIAN STATISTICS TO UNDERSTAND HOW PEOPLE RESOLVE SOME UNCERTAINTIES IN PICTORIAL IMAGES.

2/5/25

NEW IDEAS ABOUT MARKOV CHAINS - ANNE SCHILLING, UC DAVIS

WE WILL DISCUSS SOME NEW IDEAS FROM SEMIGROUP THEORY TO ANALYZE THE STATIONARY DISTRIBUTION AND MIXING TIME OF FINITE MARKOV CHAINS. AN EXAMPLE FOR A MARKOV CHAIN IS CARD SHUFFLING AND A NATURAL QUESTION IS HOW OFTEN DO YOU HAVE TO SHUFFLE THE DECK BEFORE IT IS MIXED OR RANDOM. IT TURNS OUT THAT SEMIGROUP THEORY CAN HELP ANSWER THESE QUESTIONS.

2/12/25

APPLIED MATHEMATICS AND MARINE ORGANISMS - MATEA SANTIAGO ; SSU ALUM

MANY ASPECTS OF APPLIED MATHEMATICS INFORM OUR KNOWLEDGE OF THE NATURAL WORLD. I EXPLORE THE FLUID DYNAMICS AROUND MARINE ORGANISMS. WHAT CAN FLUID DYNAMICS REVEAL ABOUT ORGANISMS? IT OFFERS VALUABLE INSIGHTS INTO HOW THE SHAPES AND BEHAVIORS OF DIFFERENT ORGANISMS OFFER COMPETITIVE ADVANTAGES. GIVEN THE COMPLEXITY OF THE EQUATIONS GOVERNING FLUID FLOW AND THE INTRICATE GEOMETRIES OF BIOLOGICAL ORGANISMS, COMPUTATIONAL TOOLS ARE OFTEN EMPLOYED TO APPROXIMATE SOLUTIONS. THIS TALK WILL BEGIN BY USING CALCULUS FUNDAMENTALS TO EXPLORE MODELING AND COMPUTATIONAL TECHNIQUES. AN INTRODUCTION TO FLUID DYNAMICS WILL SET THE STAGE FOR DISCUSSING SOME OF THE TOOLS USED IN THIS FIELD. THE SECOND HALF OF THE PRESENTATION WILL DELVE INTO FLUID FLOW AROUND BIOLOGICAL ORGANISMS, INCLUDING WORK ON CORALS AND JELLYFISH.

2/19/25

BUILDING A BETTER TOMORROW: OPTIMIZATION FOR SOCIAL JUSTICE - DREW HORTON, UNIVERSITY OF COLORADO DENVER; SSU ALUM

I SPECIALIZE IN MATHEMATICAL PROGRAMMING AND OPERATIONS RESEARCH WITH A FOCUS ON PUBLIC WELFARE AND SOCIAL JUSTICE APPLICATIONS. THIS TALK SHOWCASES PROJECTS THAT HAVE SHAPED PUBLIC POLICY, ADDRESSING EQUITABLE ACCESS TO ESSENTIAL SERVICES LIKE SUPERMARKETS AND POLLING PLACES, AS WELL AS EVACUATION PLANNING FOR NATURAL DISASTERS SUCH AS WILDFIRES.

2/26/25

WHY DO FACES LOOK DISTORTED IN SELFIES? - EMILY COOPER, UC BERKELEY OPTOMETRY AND VISION SCIENCE

MANY PEOPLE FIND THAT THE SHAPE OF THEIR FACE LOOKS A LITTLE ODD IN SELFIES—THAT IS, PHOTOS CAPTURED AT AN ARM'S LENGTH. I WILL SHOW GEOMETRICALLY AND MATHEMATICALLY THAT THERE IS NOTHING INHERENTLY DISTORTED IN THE IMAGE CAPTURED BY YOUR CAMERA WHEN YOU TAKE A SELFIE. HOWEVER, THESE IMAGES CAN CREATE PERCEPTUAL DISTORTIONS BECAUSE OF HOW YOUR BRAIN INTERPRETS INFORMATION ABOUT 3D SHAPES DEPICTED IN 2D IMAGES.

3/5/25

CRYPTOGRAPHY: A REASON TO LOVE ALGEBRA! - AARON WOOTTON, UNIVERSITY OF POLAND

AN OFTEN OVERLOOKED QUESTION IN ALGEBRA IS: WHY? WHY FIND ZEROES OF POLYNOMIALS? WHY CARE ABOUT REPRESENTATIONS OF A LINEAR EQUATION? WHY FIND INTERCEPTS? ONE ANSWER TO THIS QUESTION IS: TO DO CRYPTOGRAPHY! COME EXPLORE THE WONDERFUL WORLD OF CRYPTOGRAPHY! NO PREREQUISITES ARE REQUIRED - JUST MAKE SURE TO BRING ALONG PEN AND PAPER TO CRACK THE SECRET COMBINATIONS TO THE LOCKED SAFES!!

3/12/25

THE JOY OF MATHEMATICAL AND STATISTICAL MODELING, CONSULTING, AND PROGRAMMING - STUDENT TEAMS FROM MATH 180, 467 & 470

AS SONOMA STATE STUDENTS PROGRESS THROUGH THEIR MATH AND STATISTICS COURSES, THEY BECOME MORE AWARE OF THE CONNECTIONS ACROSS COURSEWORK, THE POWER OF USING TECHNOLOGY EFFECTIVELY, AND THE VARIETY OF MATHEMATICS AND STATISTICS APPLICATIONS IN THEIR FUTURE LIVES. SEE SOME FANTASTIC STUDENT PROJECTS THAT COMBINE MATHEMATICAL AND STATISTICAL EXPERTISE WITH STUDENT CREATIVITY IN A SELECTION OF OUR COURSES.

3/26/25

USING DATA SCIENCE TO FEED OUR COMMUNITIES - MIKAHL BANWARTH-KUHN, CSU EAST BAY

FOOD DESERTS ARE PLACES WHERE IT'S HARD TO FIND HEALTHY FOOD BECAUSE THERE AREN'T ENOUGH GROCERY STORES OR THE FOOD IS TOO EXPENSIVE. LEARN HOW DATA SCIENCE TOOLS CAN HELP US FIGURE OUT WHERE THESE AREAS ARE, WHO THEY AFFECT THE MOST, AND COME UP WITH WAYS TO BRING HEALTHY FOOD TO THESE COMMUNITIES.

4/2/25

SYMPLECTIC EMBEDDING PROBLEMS - NICKI MAGILL, UNIVERSITY OF CALIFORNIA, BERKELEY

WHEN CAN WE TAKE ONE SHAPE AND PUT IT INSIDE ANOTHER SHAPE? TO ANSWER THIS, WE NEED TO CONSIDER WHAT TO PRESERVE ABOUT A SHAPE WHEN WE TRY TO FIT IT INSIDE ANOTHER SHAPE. FOR EXAMPLE, SOMETHING WE COULD PRESERVE IS THE DISTANCE BETWEEN ANY TWO POINTS OR ITS VOLUME. WE WILL INTRODUCE THE SYMPLECTIC STRUCTURE AND LOOK AT WHAT IT MEANS TO PRESERVE THIS STRUCTURE.

4/9/25

MODULI SPACES - HANNAH K. LARSON, UC BERKELEY ****MATH FEST**** , CHAN ROSS ENDOWED TALK ON PURE MATHEMATICS

A MODULI SPACE IS A SPACE WHERE EACH POINT CORRESPONDS TO A SHAPE OF SOME KIND. IT HELPS US STUDY ALL SHAPES OF A GIVEN KIND TOGETHER. IN THIS TALK, WE'LL TAKE A GUIDED TOUR OF THE MODULI SPACE OF TRIANGLES AND THE MODULI SPACE OF CIRCLES. I HOPE THE CONCEPT OF MODULI WILL GIVE YOU A NEW PERSPECTIVE OF THESE FAMILIAR SHAPES!

4/16/25

GEOMETRIC AND STATISTICAL TECHNIQUES FOR MODELING ECOLOGICAL DATA: A COMPARISON OF SEASONALITY PATTERNS OF NORTHERN CALIFORNIAN BIRDS ACROSS EBIRD AND INATURALIST - CODY CARROLL, UNIVERSITY OF SAN FRANCISCO

CITIZEN SCIENCE PLATFORMS LIKE INATURALIST AND EBIRD SUPPORT ENGAGED COMMUNITIES OF OBSERVERS WHO PRODUCE LARGE AMOUNTS OF BIODIVERSITY DATA. HOWEVER, THE QUESTION OF HOW TO APPROPRIATELY LEVERAGE DATA JOINTLY ACROSS SEVERAL PLATFORMS FOR ECOLOGICAL RESEARCH REMAINS LARGELY UNDERSTUDIED AND NON-STANDARDIZED. IN THIS TALK, WE EXPLORE A FEW STATISTICAL AND GEOMETRIC METHODS FOR MODELING, COMPARING, AND MERGING CROWD SOURCED DATA, USING THE SEASONALITY PATTERNS OF ~250 SPECIES OF BIRDS IN NORTHERN CALIFORNIA AS AN ILLUSTRATIVE CASE STUDY.

4/23/25

THE MATHEMATICS OF WEAVING - CAROL KEIG, SONOMA STATE UNIVERSITY

WEAVING IS AS OLD AS CIVILIZATION, LIKELY THE FIRST INDUSTRY, AND WAS THE DRIVER FOR SOME OF THE EARLIEST PROGRAMMABLE AUTOMATION. IN THIS BRIEF WALK THROUGH THE HISTORY OF WEAVING, WE WILL FIND CONNECTIONS WITH EUCLID'S ELEMENTS, ADA LOVELACE'S ANALYTICAL ENGINE, AND MORE.

4/30/25

PRECISION ENGINEERING AND STATISTICAL PROCESS CONTROL - SUSAN HERRING, SONOMA STATE UNIVERSITY

IN MODERN SOCIETY, WE ALL COUNT ON THE ABILITY TO GO TO THE STORE AND PURCHASE A REPLACEMENT PIECE WHEN SOMETHING BREAKS. HOWEVER, THIS WAS NOT ALWAYS THE CASE. PRECISION ENGINEERING AND STATISTICAL PROCESS CONTROL HAVE AFFECTED MODERN SOCIETY FROM THE ABILITY TO REPLACE A BROKEN PIECE TO THE ABILITY TO INSERT A BATTERY AND KNOW IT WILL FIT. IN THIS TALK, WE WILL DISCUSS THE DEVELOPMENT OF INTERCHANGEABLE PARTS STARTING IN THE LATE 1700'S WHEN ELI WHITNEY DEVELOPED MUSKET PIECES SO PRECISELY THAT THE PIECES WERE INTERCHANGEABLE—THUS USHERING IN THE INDUSTRIAL REVOLUTION.

SERIES SUPPORTED BY INSTRUCTIONALLY-RELATED ACTIVITIES FUNDS

WEDNESDAYS AT 4PM **IN PERSON: DARWIN HALL 103**

via zoom @ https://bit.ly/4h5oxiw