Physical Sciences and Engineering

PE1 Mathematics

All areas of mathematics, pure and applied, plus mathematical foundations of computer science, mathematical physics and statistics

PE1_1 Logic and foundations
PE1_2 Algebra
PE1_3 Number theory
PE1_4 Algebraic and complex geometry
PE1_5 Lie groups, Lie algebras
PE1_6 Geometry and global analysis
PE1_7 Topology
PE1_8 Analysis
PE1_9 Operator algebras and functional analysis
PE1_10 ODE and dynamical systems
PE1_11 Theoretical aspects of partial differential equations
PE1_12 Mathematical physics
PE1_13 Probability
PE1_14 Mathematical statistics
PE1_15 Generic statistical methodology and modelling
PE1_16 Discrete mathematics and combinatorics
PE1_17 Mathematical aspects of computer science
PE1_18 Numerical analysis
PE1_19 Scientific computing and data processing
PE1_20 Control theory, optimisation and operational research
PE1_21 Application of mathematics in sciences
PE1_22 Application of mathematics in industry and society

PE2 Fundamental Constituents of Matter

Particle, nuclear, plasma, atomic, molecular, gas, and optical physics

PE2_1 Theory of fundamental interactions
PE2_2 Phenomenology of fundamental interactions
PE2_3 Experimental particle physics with accelerators
PE2_4 Experimental particle physics without accelerators
PE2_5 Classical and quantum physics of gravitational interactions
PE2_6 Nuclear, hadron and heavy ion physics
PE2_7 Nuclear and particle astrophysics
PE2_8 Gas and plasma physics
PE2_9 Electromagnetism
PE2_10 Atomic, molecular physics
PE2_11 Ultra-cold atoms and molecules
PE2_12 Optics, non-linear optics and nano-optics
PE2_13 Quantum optics and quantum information
PE2_14 Lasers, ultra-short lasers and laser physics
PE2_15 Thermodynamics
PE2_16 Non-linear physics
PE2_17 Metrology and measurement
PE2_18 Equilibrium and non-equilibrium statistical mechanics: steady states and dynamics

PE3 Condensed Matter Physics

Structure, electronic properties, fluids, nanosciences, biological physics

PE3_1 Structure of solids, material growth and characterisation
PE3_2 Mechanical and acoustical properties of condensed matter, lattice dynamics
PE3_3 Transport properties of condensed matter
PE3_4 Electronic properties of materials, surfaces, interfaces, nanostructures
PE3_5 Physical properties of semiconductors and insulators
PE3_6 Macroscopic quantum phenomena, e.g. superconductivity, superfluidity, quantum Hall effect
PE3_7 Spintronics

PE3_8 Magnetism and strongly correlated systems
PE3_9 Condensed matter – beam interactions (photons, electrons, etc.)
PE3_10 Nanophysics, e.g. nanoelectronics, nanophotonics, nanomagnetism, nanoelectromechanics
PE3_11 Mesoscopic quantum physics and solid-state quantum technologies
PE3_12 Molecular electronics
PE3_13 Structure and dynamics of disordered systems, e.g. soft matter (gels, colloids, liquid crystals), granular matter, liquids, glasses, defects
PE3_14 Fluid dynamics (physics)
PE3_15 Statistical physics: phase transitions, condensed matter systems, models of complex systems, interdisciplinary applications
PE3_16 Physics of biological systems

PE4 Physical and Analytical Chemical Sciences

Analytical chemistry, chemical theory, physical chemistry/chemical physics

PE4_1 Physical chemistry
PE4_2 Spectroscopic and spectrometric techniques
PE4_3 Molecular architecture and Structure
PE4_4 Surface science and nanostructures
PE4_5 Analytical chemistry
PE4_6 Chemical physics
PE4_7 Chemical instrumentation
PE4_8 Electrochemistry, electrodialysis, microfluidics, sensors
PE4_9 Method development in chemistry
PE4_10 Heterogeneous catalysis
PE4_11 Physical chemistry of biological systems
PE4_12 Chemical reactions: mechanisms, dynamics, kinetics and catalytic reactions
PE4_13 Theoretical and computational chemistry
PE4_14 Radiation and Nuclear chemistry
PE4_15 Photochemistry
PE4_16 Corrosion
PE4_17 Characterisation methods of materials
PE4_18 Environment chemistry

PE5 Synthetic Chemistry and Materials

New materials and new synthetic approaches, structure-properties relations, solid state chemistry, molecular architecture, organic chemistry

PE5_1 Structural properties of materials
PE5_2 Solid state materials chemistry
PE5_3 Surface modification
PE5_4 Thin films
PE5_5 Ionic liquids
PE5_6 New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles
PE5_7 Biomaterials synthesis
PE5_8 Intelligent materials synthesis – self assembled materials
PE5_9 Coordination chemistry
PE5_10 Colloid chemistry
PE5_11 Biological chemistry and chemical biology
PE5_12 Chemistry of condensed matter
PE5_13 Homogeneous catalysis
PE5_14 Macromolecular chemistry
PE5_15 Polymer chemistry
PE5_16 Supramolecular chemistry
PE5_17 Organic chemistry
PE5_18 Medicinal chemistry

PE6 Computer Science and Informatics

Informatics and information systems, computer science, scientific computing, intelligent systems

PE6_1 Computer architecture, embedded systems, operating systems
PE6_2 Distributed systems, parallel computing, sensor networks, cyber-physical systems
PE6_3 Software engineering, programming languages and systems
PE6_4 Theoretical computer science, formal methods, automata
PE6_5 Security, privacy, cryptology, quantum cryptography
PE6_6 Algorithms and complexity, distributed, parallel and network algorithms, algorithmic game theory
PE6_7 Artificial intelligence, intelligent systems, natural language processing
PE6_8 Computer graphics, computer vision, multimedia, computer games
PE6_9 Human computer interaction and interface, visualisation
PE6_10 Web and information systems, data management systems, information retrieval and digital libraries, data fusion
PE6_11 Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)
PE6_12 Scientific computing, simulation and modelling tools
PE6_13 Bioinformatics, bio-inspired computing, and natural computing
PE6_14 Quantum computing (formal methods, algorithms and other computer science aspects)

PE7 Systems and Communication Engineering

Electrical, electronic, communication, optical and systems engineering

PE7_1 Control engineering
PE7_2 Electrical engineering: power components and/or systems
PE7_3 Simulation engineering and modelling
PE7_4 (Micro- and nano-) systems engineering
PE7_5 (Micro- and nano-) electronic, optoelectronic and photonic components
PE7_6 Communication systems, wireless technology, high-frequency technology
PE7_7 Signal processing
PE7_8 Networks, e.g. communication networks and nodes, Internet of Things, sensor networks, networks of robots
PE7_9 Man-machine interfaces
PE7_10 Robotics
PE7_11 Components and systems for applications (in e.g. medicine, biology, environment)
PE7_12 Electrical energy production, distribution, applications

PE8 Products and Processes Engineering

Product and process design, chemical, civil, environmental, mechanical, vehicle engineering, energy processes and relevant computational methods

PE8_1 Aerospace engineering
PE8_2 Chemical engineering, technical chemistry
PE8_3 Civil engineering, architecture, offshore construction, lightweight construction, geotechnics
PE8_4 Computational engineering
PE8_5 Fluid mechanics
PE8_6 Energy processes engineering
PE8_7 Mechanical engineering
PE8_8 Propulsion engineering, e.g. hydraulic, turbo, piston, hybrid engines
PE8_9 Production technology, process engineering
PE8_10 Manufacturing engineering and industrial design
PE8_11 Environmental engineering, e.g. sustainable design, waste and water treatment, recycling, regeneration or recovery of compounds, carbon capture & storage
PE8_12 Naval/marine engineering
PE8_13 Industrial bioengineering
PE8_14 Automotive and rail engineering; multi-/inter-modal transport engineering

PE9 Universe Sciences

Astro-physics/-chemistry/-biology; solar system; planetary systems; stellar, galactic and extragalactic astronomy; cosmology; space sciences; astronomical instrumentation and data

PE9_1 Solar physics – the Sun and the heliosphere
PE9_2 Solar system science

PE9_3 Exoplanetary science, formation and characterization of extrasolar planets
PE9_4 Astrobiology
PE9_5 Interstellar medium and star formation
PE9_6 Stars – stellar physics, stellar systems
PE9_7 The Milky Way
PE9_8 Galaxies – formation, evolution, clusters
PE9_9 Cosmology and large-scale structure, dark matter, dark energy
PE9_10 Relativistic astrophysics and compact objects
PE9_11 Gravitational wave astronomy
PE9_12 High-energy and particle astronomy
PE9_13 Astronomical instrumentation and data, e.g. telescopes, detectors, techniques, archives, analyses

PE10 Earth System Science

Physical geography, geology, geophysics, atmospheric sciences, oceanography, climatology, cryology, ecology, global environmental change, biogeochemical cycles, natural resources management

PE10_1 Atmospheric chemistry, atmospheric composition, air pollution
PE10_2 Meteorology, atmospheric physics and dynamics
PE10_3 Climatology and climate change
PE10_4 Terrestrial ecology, land cover change
PE10_5 Geology, tectonics, volcanology
PE10_6 Palaeoclimatology, palaeoecology
PE10_7 Physics of earth's interior, seismology, geodynamics
PE10_8 Oceanography (physical, chemical, biological, geological)
PE10_9 Biogeochemistry, biogeochemical cycles, environmental chemistry
PE10_10 Mineralogy, petrology, igneous petrology, metamorphic petrology
PE10_11 Geochemistry, cosmochemistry, crystal chemistry, isotope geochemistry, thermodynamics
PE10_12 Sedimentology, soil science, palaeontology, earth evolution
PE10_13 Physical geography, geomorphology
PE10_14 Earth observations from space/remote sensing
PE10_15 Geomagnetism, palaeomagnetism
PE10_16 Ozone, upper atmosphere, ionosphere
PE10_17 Hydrology, hydrogeology, engineering and environmental geology, water and soil pollution
PE10_18 Cryosphere, dynamics of snow and ice cover, sea ice, permafrosts and ice sheets
PE10_19 Planetary geology and geophysics
PE10_20 Geohazards
PE10_21 Earth system modelling and interactions

PE11 Materials Engineering

Advanced materials development: performance enhancement, modelling, large-scale preparation, modification, tailoring, optimisation, novel and combined use of materials, etc.

PE11_1 Engineering of biomaterials, biomimetic, bioinspired and bio-enabled materials
PE11_2 Engineering of metals and alloys
PE11_3 Engineering of ceramics and glasses
PE11_4 Engineering of polymers and plastics
PE11_5 Engineering of composites and hybrid materials
PE11_6 Engineering of carbon materials
PE11_7 Engineering of metal oxides
PE11_8 Engineering of alternative established or emergent materials
PE11_9 Nanomaterials engineering, e.g. nanoparticles, nanoporous materials, 1D & 2D nanomaterials
PE11_10 Soft materials engineering, e.g. gels, foams, colloids
PE11_11 Porous materials engineering, e.g. covalent-organic, metal-organic, porous aromatic frameworks
PE11_12 Semi-conducting and magnetic materials engineering
PE11_13 Metamaterials engineering
PE11_14 Computational methods for materials engineering

Life Sciences

LS1 Molecules of Life: Biological Mechanisms, Structures and Functions

For all organisms:

Molecular biology, biochemistry, structural biology, molecular biophysics, synthetic and chemical biology, drug design, innovative methods and modelling

LS1_1 Macromolecular complexes including interactions involving nucleic acids, proteins, lipids and carbohydrates
LS1_2 Biochemistry
LS1_3 DNA and RNA biology
LS1_4 Protein biology
LS1_5 Lipid biology
LS1_6 Glycobiology
LS1_7 Molecular biophysics, biomechanics, bioenergetics
LS1_8 Structural biology
LS1_9 Molecular mechanisms of signalling processes
LS1_10 Synthetic biology
LS1_11 Chemical biology
LS1_12 Protein design
LS1_13 Early translational research and drug design
LS1_14 Innovative methods and modelling in molecular, structural and synthetic biology

LS2 Integrative Biology: from Genes and Genomes to Systems

For all organisms:

Genetics, epigenetics, genomics and other 'omics studies, bioinformatics, systems biology, genetic diseases, gene editing, innovative methods and modelling, 'omics for personalised medicine

LS2_1 Genetics
LS2_2 Gene editing
LS2_3 Epigenetics
LS2_4 Gene regulation
LS2_5 Genomics
LS2_6 Metagenomics
LS2_7 Transcriptomics
LS2_8 Proteomics
LS2_9 Metabolomics
LS2_10 Glycomics/Lipidomics
LS2_11 Bioinformatics and computational biology
LS2_12 Biostatistics
LS2_13 Systems biology
LS2_14 Genetic diseases
LS2_15 Integrative biology for personalised medicine
LS2_16 Innovative methods and modelling in integrative biology

LS3 Cellular, Developmental and Regenerative Biology

For all organisms:

Structure and function of the cell, cell-cell communication, embryogenesis, tissue differentiation, organogenesis, growth, development, evolution of development, organoids, stem cells, regeneration, therapeutic approaches

LS3_1 Cell cycle, cell division and growth
LS3_2 Cell senescence, cell death, autophagy, cell ageing
LS3_3 Cell behaviour, including control of cell shape, cell migration
LS3_4 Cell junctions, cell adhesion, the extracellular matrix, cell communication
LS3_5 Cell signalling and signal transduction, exosome biology
LS3_6 Organelle biology and trafficking
LS3_7 Mechanobiology of cells, tissues and organs
LS3_8 Embryogenesis, pattern formation, morphogenesis
LS3_9 Cell differentiation, formation of tissues and organs

LS3_10 Developmental genetics
LS3_11 Evolution of developmental strategies
LS3_12 Organoids
LS3_13 Stem cells
LS3_14 Regeneration
LS3_15 Development of cell-based therapeutic approaches for tissue regeneration
LS3_16 Functional imaging of cells and tissues
LS3_17 Theoretical modelling in cellular, developmental and regenerative biology

LS4 Physiology in Health, Disease and Ageing

Organ and tissue physiology, comparative physiology, physiology of ageing, pathophysiology, interorgan and tissue communication, endocrinology, nutrition, metabolism, interaction with the microbiome, non-communicable diseases including cancer (and except disorders of the nervous system and immunity-related diseases)

LS4_1 Organ and tissue physiology and pathophysiology
LS4_2 Comparative physiology
LS4_3 Physiology of ageing
LS4_4 Endocrinology
LS4_5 Non-hormonal mechanisms of inter-organ and tissue communication
LS4_6 Microbiome and host physiology
LS4_7 Nutrition and exercise physiology
LS4_8 Impact of stress (including environmental stress) on physiology
LS4_9 Metabolism and metabolic disorders, including diabetes and obesity
LS4_10 The cardiovascular system and cardiovascular diseases
LS4_11 Haematopoiesis and blood diseases
LS4_12 Cancer
LS4_13 Other non-communicable diseases (except disorders of the nervous system and immunity-related diseases)

LS5 Neuroscience and Disorders of the Nervous System

Nervous system development, homeostasis and ageing, nervous system function and dysfunction, systems neuroscience and modelling, biological basis of cognitive processes and of behaviour, neurological and mental disorders

LS5_1 Neuronal cells
LS5_2 Glial cells and neuronal-glial communication
LS5_3 Neural development and related disorders
LS5_4 Neural stem cells
LS5_5 Neural networks and plasticity
LS5_6 Neurovascular biology and blood-brain barrier
LS5_7 Sensory systems, sensation and perception, including pain
LS5_8 Neural basis of behaviour
LS5_9 Neural basis of cognition
LS5_10 Ageing of the nervous system
LS5_11 Neurological and neurodegenerative disorders
LS5_12 Mental disorders
LS5_13 Nervous system injuries and trauma, stroke
LS5_14 Repair and regeneration of the nervous system
LS5_15 Neuroimmunology, neuroinflammation
LS5_16 Systems and computational neuroscience
LS5_17 Imaging in neuroscience
LS5_18 Innovative methods and tools for neuroscience

LS6 Immunity, Infection and Immunotherapy

The immune system, related disorders and their mechanisms, biology of infectious agents and infection, biological basis of prevention and treatment of infectious diseases, innovative immunological tools and approaches, including therapies

LS6_1 Innate immunity
LS6_2 Adaptive immunity
LS6_3 Regulation of the immune response
LS6_4 Immune-related diseases
LS6_5 Biology of pathogens (e.g. bacteria, viruses, parasites, fungi)
LS6_6 Infectious diseases
LS6_7 Mechanisms of infection
LS6_8 Biological basis of prevention and treatment of infection
LS6_9 Antimicrobials, antimicrobial resistance
LS6_10 Vaccine development
LS6_11 Innovative immunological tools and approaches, including therapies

LS7 Prevention, Diagnosis and Treatment of Human Diseases

Medical technologies and tools for prevention, diagnosis and treatment of human diseases, therapeutic approaches and interventions, pharmacology, preventative medicine, epidemiology and public health, digital medicine

LS7_1 Medical imaging for prevention, diagnosis and monitoring of diseases
LS7_2 Medical technologies and tools (including genetic tools and biomarkers) for prevention, diagnosis, monitoring and treatment of diseases
LS7_3 Nanomedicine
LS7_4 Regenerative medicine
LS7_5 Applied gene, cell and immune therapies
LS7_6 Other medical therapeutic interventions, including transplantation
LS7_7 Pharmacology and toxicology
LS7_8 Effectiveness of interventions, including resistance to therapies
LS7_9 Public health and epidemiology
LS7_10 Preventative and prognostic medicine
LS7_11 Environmental health, occupational medicine
LS7_12 Health care, including care for the ageing population
LS7_13 Palliative medicine
LS7_14 Digital medicine, e-medicine, medical applications of artificial intelligence
LS7_15 Medical ethics

LS8 Environmental Biology, Ecology and Evolution

For all organisms:

Ecology, biodiversity, environmental change, evolutionary biology, behavioural ecology, microbial ecology, marine biology, ecophysiology, theoretical developments and modelling

LS8_1 Ecosystem and community ecology, macroecology
LS8_2 Biodiversity
LS8_3 Conservation biology
LS8_4 Population biology, population dynamics, population genetics
LS8_5 Biological aspects of environmental change, including climate change
LS8_6 Evolutionary ecology
LS8_7 Evolutionary genetics
LS8_8 Phylogenetics, systematics, comparative biology
LS8_9 Macroevolution and paleobiology
LS8_10 Ecology and evolution of species interactions
LS8_11 Behavioural ecology and evolution
LS8_12 Microbial ecology and evolution
LS8_13 Marine biology and ecology
LS8_14 Ecophysiology, from organisms to ecosystems
LS8_15 Theoretical developments and modelling in environmental biology, ecology, and evolution

LS9 Biotechnology and Biosystems Engineering

Biotechnology using all organisms, biotechnology for environment and food applications, applied plant and animal sciences, bioengineering and synthetic biology, biomass and biofuels, biohazards

LS9_1 Bioengineering for synthetic and chemical biology

LS9_2 Applied genetics, gene editing and transgenic organisms
LS9_3 Bioengineering of cells, tissues, organs and organisms
LS9_4 Microbial biotechnology and bioengineering
LS9_5 Food biotechnology and bioengineering
LS9_6 Marine biotechnology and bioengineering
LS9_7 Environmental biotechnology and bioengineering
LS9_8 Applied plant sciences, plant breeding, agroecology and soil biology
LS9_9 Plant pathology and pest resistance
LS9_10 Veterinary and applied animal sciences
LS9_11 Biomass production and utilisation, biofuels
LS9_12 Ecotoxicology, biohazards and biosafety

Social Sciences and Humanities

SH1 Individuals, Markets and Organisations

Economics, finance, management

SH1_1 Macroeconomics; monetary economics; economic growth
SH1_2 International trade; international management; international business; spatial economics
SH1_3 Development economics; structural change; political economy of development
SH1_4 Finance; asset pricing; international finance; market microstructure
SH1_5 Corporate finance; banking and financial intermediation; accounting; auditing; insurance
SH1_6 Econometrics; operations research
SH1_7 Behavioural economics; experimental economics; neuro-economics
SH1_8 Microeconomic theory; game theory; decision theory
SH1_9 Industrial organisation; entrepreneurship; R&D and innovation
SH1_10 Management; strategy; organisational behaviour
SH1_11 Human resource management; operations management, marketing
SH1_12 Environmental economics; resource and energy economics; agricultural economics
SH1_13 Labour and demographic economics
SH1_14 Health economics; economics of education
SH1_15 Public economics; political economics; law and economics
SH1_16 Historical economics; quantitative economic history; institutional economics; economic systems

SH2 Institutions, Governance and Legal Systems

Political science, international relations, law

SH2_1 Political systems, governance
SH2_2 Democratisation and social movements
SH2_3 Conflict resolution, war, peace building, international law
SH2_4 Legal studies, constitutions, human rights, comparative law
SH2_5 International relations, global and transnational governance
SH2_6 Humanitarian assistance and development
SH2_7 Political and legal philosophy
SH2_8 Big data in political and legal studies

SH3 The Social World and Its Diversity

Sociology, social psychology, social anthropology, education sciences, communication studies

SH3_1 Social structure, social mobility, social innovation
SH3_2 Inequalities, discrimination, prejudice
SH3_3 Aggression and violence, antisocial behaviour, crime
SH3_4 Social integration, exclusion, prosocial behaviour
SH3_5 Attitudes and beliefs
SH3_6 Social influence; power and group behaviour
SH3_7 Kinship; diversity and identities, gender, interethnic relations
SH3_8 Social policies, welfare, work and employment
SH3_9 Poverty and poverty alleviation
SH3_10 Religious studies, ritual; symbolic representation
SH3_11 Social aspects of teaching and learning, curriculum studies, education and educational policies
SH3_12 Communication and information, networks, media

SH3_13 Digital social research
SH3_14 Social studies of science and technology

SH4 The Human Mind and Its Complexity

Cognitive science, psychology, linguistics, theoretical philosophy

SH4_1 Cognitive basis of human development and education, developmental disorders; comparative cognition
SH4_2 Personality and social cognition; emotion
SH4_3 Clinical and health psychology
SH4_4 Neuropsychology
SH4_5 Attention, perception, action, consciousness
SH4_6 Learning, memory; cognition in ageing
SH4_7 Reasoning, decision-making; intelligence
SH4_8 Language learning and processing (first and second languages)
SH4_9 Theoretical linguistics; computational linguistics
SH4_10 Language typology; historical linguistics
SH4_11 Pragmatics, sociolinguistics, linguistic anthropology, discourse analysis
SH4_12 Philosophy of mind, philosophy of language
SH4_13 Philosophy of science, epistemology, logic

SH5 Cultures and Cultural Production

Literary studies, cultural studies, study of the arts, philosophy

SH5_1 Classics, ancient literature and art
SH5_2 Theory and history of literature, comparative literature
SH5_3 Philology; text and image studies
SH5_4 Visual and performing arts, film, design and architecture
SH5_5 Music and musicology; history of music
SH5_6 History of art and architecture, arts-based research
SH5_7 Museums, exhibitions, conservation and restoration
SH5_8 Cultural studies, cultural identities and memories, cultural heritage
SH5_9 Metaphysics, philosophical anthropology; aesthetics
SH5_10 Ethics and its applications; social philosophy
SH5_11 History of philosophy
SH5_12 Computational modelling and digitisation in the cultural sphere

SH6 The Study of the Human Past

Archaeology and history

SH6_1 Historiography, theory and methods in history, including the analysis of digital data
SH6_2 Classical archaeology, history of archaeology, social archaeology
SH6_3 General archaeology, archaeometry, landscape archaeology
SH6_4 Prehistory, palaeoanthropology, palaeodemography, protohistory, bioarchaeology
SH6_5 Palaeography and codicology
SH6_6 Ancient history
SH6_7 Medieval history
SH6_8 Early modern history
SH6_9 Modern and contemporary history
SH6_10 Colonial and post-colonial history
SH6_11 Global history, transnational history, comparative history, entangled histories
SH6_12 Social and economic history
SH6_13 Gender history, cultural history, history of collective identities and memories, history of religions
SH6_14 History of ideas, intellectual history, history of economic thought
SH6_15 History of science, medicine and technologies

SH7 Human Mobility, Environment, and Space

Human geography, demography, health, sustainability science, territorial planning, spatial analysis

SH7_1 Human, economic and social geography
SH7_2 Migration

SH7_3 Population dynamics: households, family and fertility
SH7_4 Social aspects of health, ageing and society
SH7_5 Sustainability sciences, environment and resources
SH7_6 Environmental and climate change, societal impact and policy
SH7_7 Cities; urban, regional and rural studies
SH7_8 Land use and planning
SH7_9 Energy, transportation and mobility
SH7_10 GIS, spatial analysis; big data in geographical studies