ARIZONA STATE UNIVERSITY

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GENERAL STUDIES PROGRAM COURSE PROPOSAL COVER FORM

Courses submitted to the GSC between 2/1 and 4/30 if approved, will be effective the following Spring.

Courses submitted between 5/1 and 1/31 if approved, will be effective the following Fall.

(SUBMISSION VIA ADOBE.PDF FILES IS PREFERRED)

DATE 3/1/10

1. ACADEMIC UNIT: School of Geographical Sciences and Urban Planning

2. COURSE PROPOSED: GPH (prefix) 473 (number) Geographic Information Science II (title) 4 (semester hours)

3. CONTACT PERSON: Name: Alan Murray Phone: x5-7533

   Mail Code: 5302 E-Mail: atmurray@asu.edu

4. ELIGIBILITY: New courses must be approved by the Tempe Campus Curriculum Subcommittee and must have a regular course number. For the rules governing approval of omnibus courses, contact the General Studies Program Office at 965–0739.

5. AREA(S) PROPOSED COURSE WILL SERVE. A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study. **(Please submit one designation per proposal)**

Core Areas

Literacy and Critical Inquiry–L ☐
Mathematical Studies–MA ☐ CS ☒
Humanities, Fine Arts and Design–HU ☐
Social and Behavioral Sciences–SB ☐
Natural Sciences–SQ ☐ SG ☐

Awareness Areas

Global Awareness–G ☐
Historical Awareness–H ☐
Cultural Diversity in the United States–C ☐

6. DOCUMENTATION REQUIRED.
   (1) Course Description
   (2) Course Syllabus
   (3) Criteria Checklist for the area
   (4) Table of Contents from the textbook used, if available

7. ***In the space provided below (or on a separate sheet), please also provide a description of how the course meets the specific criteria in the area for which the course is being proposed.***

CROSS-LISTED COURSES: ☒ No ☐ Yes; Please identify courses: ________

Is this amultisection course?: ☒ No ☐ Yes; Is it governed by a common syllabus? ________

LUC ANSELIN
Chair/Director (Print or Type)

[signature]
Chair/Director (Signature)

Date: 3/3/2010

Rev. 1/94, 4/95, 7/98, 4/00, 1/02, 10/08

General Studies Course Proposal Documentation

GPH 473: Geographic Information Science II

Table of Contents:

Course Description

The objective of this course is to introduce advanced topics in Geographic Information Science. Students will be exposed to advanced, cutting-edge research questions and problems in GI Science, important to both the academic and professional community. Through this course, students will develop a sound basis for understanding the operational functionality of modern GIS technology.

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[CS] CRITERIA

A COMPUTER/STATISTICS/QUANTITATIVE APPLICATIONS [CS] COURSE MUST SATISFY ONE OF THE FOLLOWING CRITERIA: 1, 2, OR 3

YES	NO		Identify Documentation Submitted
		1. Computer applications*: courses must satisfy both **a** and **b**:	
☒	☐	**a.** Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	Syllabus for course and lab indicates software and topics.
		b. Course requires students to analyze and implement procedures that are applicable to at least one of the following problem domains **(check those applicable)**:	
☒	☐	**i.** Spreadsheet analysis, systems analysis and design, and decision support systems.	Lab 4 provided in Appendix 1
☒	☐	**ii.** Graphic/artistic design using computers.	Map making fundamentals emphasized throughout
☐	☐	**iii.** Music design using computer software.	
☐	☐	**iv.** Modeling, making extensive use of computer simulation.	
☒	☐	**v.** Statistics studies stressing the use of computer software.	Lab 10 example provided in Appendix 2

*The **computer applications** requirement **cannot** be satisfied by a course, the content of which is restricted primarily to word processing or report preparation skills; learning a computer language or a computer software package; or the study of the social impact of computers. Courses that emphasize the use of a computer software package or the learning of a computer programming language are acceptable, provided that students are required to understand, at an appropriate level, **the theoretical principles embodied in the operation of the software and are required to construct, test, and implement procedures that use the software to accomplish tasks in the applicable problem domains.**

YES	NO		Identify Documentation Submitted
		2. Statistical applications: courses must satisfy both **a** and **b**.	
■	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus, or a course already approved as satisfying the MA requirement.	
☐	☐	**b.** The course must be focused principally on developing knowledge in statistical inference and include coverage of all of the following:	

Course Prefix	Number	Title	Designation
GPH	473	Geographic Information Science II	**CS**

Organizer to explain how the course meets CS Criteria.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
1a. Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	Students in GIScience II use at least two software programs that involve the creation of spatial information, the quantitative analysis of spatial information, and statistical hypothesis testing.	In **syllabus**, course objective states: *The objective of this course is to introduce advanced topics in Geographic Information Science. Students will be exposed to advanced, cutting-edge research questions and problems in GI Science, important to both the academic and professional community. Through this course, students will develop a sound basis for understanding the operational functionality of modern GIS technology.*
1b i. Course requires students to analyze and implement procedures that are applicable to … Spreadsheet analysis, systems analysis and design, and decision support systems.	GIScience requires the analysis of spatial information, pattern assessment and management/decision making. Lectures introduce basic principles founded in the management sciences, computer sciences, and public policy. Major topic are supported through labs, requiring students to create spatial data and carry out associated analysis using supporting computer software (ArcGIS and GeoDa). This provides students with a developed skill set, as well as the supporting theoretical concepts.	**Labs 4, 5 and 6**. For example, the lab 4 introduction reads: *You want to find a suitable location in Phoenix to locate a new retail center. Business experience tells you that families with above average income are your target market. You also know people do not travel far from home to visit a store. Your previous studies also inform you that locations close to existing retail centers would not be good. So, use GIS data to find the suitable area to locate the new retail center.*
1b ii. Course requires students to analyze and implement procedures that are applicable to … Graphic/artistic design using computers.	In all GIS work is the need for cartography and graphic design. Lectures elaborate on fundamental techniques of cartography, and an expectation of advanced understanding of supporting approaches. Each lab implicitly demands the further development of capabilities to use computer software to carry out the project analysis. This hands-on approach allows students to develop problem-solving skills simultaneously in both the	A theme that is prevalent through all labs is the ability to use the cartographic capabilities in GIS for enhancing knowledge and support decision making.

	software tools and the subject domain of cartography. Finally, there is a course project where a problem is posed and analyzed using GIS software, implementing techniques discussed in class.	
1b v. Course requires students to analyze and implement procedures that are applicable to … Statistics studies stressing the use of computer software.	A number of labs and associated lectures focus on the use of statistical methods for the analysis of spatial information. Second, there is a course project where a problem is posed and analyzed using GIS software, requiring statistical techniques discussed in class to be applied.	**Labs 8 and 10**. For example, the lab 10 introduction reads: *In this exercise you will learn to use Geoda software to implement some simple EDA (Exploratory Data Analysis) techniques. Those techniques are some descriptive statistics, which include Histogram, Box Plot, and Scatter Plot. You will also experience a very cool function, "Brushing", which is the animated linking operation, by using Geoda.*

GPH 473: Geographic Information Science II

Instructor

Professor Alan Murray
Office: 5610 Coor
Email: atmurray@asu.edu
Office Hours: Wednesday 12-2 pm, or by appointment

Teaching Assistant

Yin Liu
Office: 5643 Coor
Email: yin.liu.1@asu.edu
Office Hours: Wednesday 10-12 pm, Thursday 10-12 pm, or by appointment

Lecture Time and Location

Tuesday and Thursday 12-1:15 pm
Coor L1-18

Course Description and Objectives

The objective of this course is to introduce advanced topics in Geographic Information Science. Students will be exposed to advanced, cutting-edge research questions and problems in GI Science, important to both the academic and professional community. Through this course, students will develop a sound basis for understanding the operational functionality of modern GIS technology.

Text

Worboys, M. and M. Duckham (2004). *GIS: A Computing Perspective* (Boca Raton: CRC Press).

Prerequisites

Introductory background in GIS. GPH 373 (Geographic Information Science I) or equivalent.

Class Policies

Students must be concurrently enrolled in the laboratory portion of this class, currently listed under GPH 494 (Friday 10-12). Student must pass the lab portion of the course to pass the entire course.

Class Attendance: It is mandatory that you attend class. Preparation for and participation in every lecture is expected.

Assignments: There will be a number of assignments and problem exercises throughout the semester.

Project: A capstone requirement for this course is a GIS based research project. Utilizing the GISci skills developed over the semester, each student will collaborate with 3-4 peers on an approved topic. Each team is required to prepare a final report and to present their project to the class. Details on the project will be given out early in the semester.

Exams: There will be a midterm and final exam in this course.

Grading components:

Participation	5%
Assignments	15%
Project	20%
Midterm exam	25%
Final exam	35%

Incompletes: Only in the rarest of circumstances will an Incomplete grade be given. As per university policy, an incomplete automatically reverts to an E after one year if the agreed upon work has not been successfully completed.

Academic Integrity

The ASU Student Academic Integrity Policy (http://provost.asu.edu/academicintegrity) states that "[e]ach student must act with honesty and integrity, and must respect the rights of others in carrying out all academic assignments." This policy also defines academic dishonesty and sets a process for faculty members and colleges to sanction dishonesty. Violations of this policy fall into, but are not limited to, the following broad areas: cheating on an academic evaluation or assignment; plagiarism; academic deceit; aiding others to cheat or plagiarize and inappropriate collaboration. See me if you have any questions concerning academic integrity. Sanctions for academic dishonesty are referred to College and University bodies, in accordance with ASU guidelines.

Course Syllabus

Week	Dates	Topic(s)
1	January 19 January 21	Introduction (Chapter 1) Database concepts (Chapter 2) 1b i
2	January 26 January 28	Object orientation Spatial concepts (Chapter 3)
3	February 2 February 4	Geospatial models (Chapter 4) – Raster 1b i cont. (Raster operations)
4	February 9 February 11	Data representation (Chapter 5) – Vector cont. (Vector operations)

5	February 16 February 18	Hierarchical data structures Project groups	
6	February 23 February 25	cont. (Hierarchical operations) cont.	
7	March 2 March 4	Networks **Midterm exam**	1b i
8	March 9 March 11	cont. (Network operations) Project groups	
9	March 16 March 18	**No class** (Spring break)	
10	March 23 March 25	Shape Interpolation	1b v
11	March 30 April 1	DEM/TIN Project groups	
12	April 6 April 8	Visualization Uncertainty	1b ii
13	April 13 April 15	ESDA Project groups (AAG conference)	1b v
14	April 20 April 22	Time cont.	
15	April 27 April 28	Project presentations cont.	
16	May 4	Last day of class	
Final		**Final exam (Thursday, May 6, 2010 at 9:50 - 11:40 am)**	

Additional material and updates found online through Blackboard.

Worboys & Duckham (2004)
GIS: A Computing Perspective, 2nd Ed.

Contents

1b ii

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GPH 494 (lab for GPH 473): Geographic Information Science II Lab

Instructor

Professor Alan Murray
Office: 5610 Coor
Email: atmurray@asu.edu
Office Hours: Wednesday 12-2 pm, or by appointment

Teaching Assistant

Yin Liu
Office: 5643 Coor
Email: yin.liu.1@asu.edu
Office Hours: Wednesday 10-12 pm, Thursday 10-12 pm, or by appointment

Lecture Time and Location

Friday 10 am -12 pm
Coor L1-18

Course Description and Objectives

This course is the laboratory for GPH 473 (Geographic Information Science II). The objective of this lab is to introduce advanced topics in Geographic Information Science through the use of commercial GIS software (ArcGIS). Students will address research questions and problems using GIS software, exploring data storage and processing efficiency issues as well as advanced spatial analysis methods.

Class Policies

Students must be concurrently enrolled in GPH 473.

Assignments: There will be weekly GIS application assignments throughout the semester. The laboratory exercises will require the use of ArcGIS. Students are required to turn in their own work (see Academic Integrity notice below).

Incompletes: Only in the rarest of circumstances will an Incomplete grade be given. As per university policy, an incomplete automatically reverts to an E after one year if the agreed upon work has not been successfully completed.

Academic Integrity

The ASU Student Academic Integrity Policy (http://provost.asu.edu/academicintegrity) states that “[e]ach student must act with honesty and integrity, and must respect the rights of others in carrying out all academic assignments." This policy also defines academic dishonesty and sets a process for faculty members and colleges to sanction dishonesty. Violations of this policy fall into, but are not limited to, the following broad areas: cheating on an academic evaluation or assignment; plagiarism; academic deceit; aiding others to cheat or plagiarize and inappropriate collaboration. See me if you have any questions concerning academic integrity. Sanctions for academic dishonesty are referred to College and University bodies, in accordance with ASU guidelines.

Course Syllabus

Week	Dates	Topic(s)	
1	January 22	Lab 1 – Data creation	1b i
2	January 29	Lab 2 – Data storage and processing	
3	February 5	Lab 3 – Raster data	
4	February 12	Lab 4 – Raster data analysis	
5	February 19	cont.	
6	February 26	Lab 5 – Vector data analysis	
7	March 5		
8	March 12	Lab 6 – Network analysis (shortest paths)	1b v
9	March 19	No class – Spring Break	
10	March 26	Lab 7 – Shape analysis	1b v
11	April 2	Lab 8 – Interpolation	
12	April 9	Lab 9 – Surface analysis (viewshed)	1b v
13	April 16	cont.	
14	April 23	Lab 10 – ESDA and GeoDA	1b v
15	April 30	Summary and review	
16			

Lab materials and data can be found online through the Blackboard site for this course.

Appendix 1

Geography 473
Geographic Information Systems II
Fall 2009

Professor: Alan Murray
T.A.: Yin Liu

Lab #4: Map Algebra and Suitability Analysis

Due: February 19, 2010 (before class)

In this exercise you will use spatial analyst and the map calculator to create a suitability map for locating a new retail center. 1b. i

MAP SUITABILE AREA FOR NEW RETAIL CENTER

You want to find a suitable location in Phoenix to locate a new retail center. Business experience tells you that families with above average income are your target market. You also know people do not travel far from home to visit a store. Your previous studies also inform you that locations close to existing retail centers would not be good. So, use GIS data to find the suitable area to locate the new retail center.

What you have:

- Population Tracts with 'median family income' for each tract
- The location of existing retail centers
- The routes of main roads and the newly constructed light-rail in Phoenix

➢ Start ArcMap, and make sure the spatial analyst extension is activated
From the View menu, choose Data Frame Properties. Set Map units to meters, then click 'OK'

➢ Load Required Data
Press the add theme button and add the 'Existing Retail Centers', 'Major Street', 'Lightrail Line' and 'Tract Income' themes.

MAP SUITABLE DISTANCES

You do not want competition with existing shops, so the suitability of an area also depends upon its distance from existing shops. To evaluate the area, you want to score the distant area from existing retail centers highly. The reclassification should follow these parameters: 0 – 3000 m = 1; 3000 – 5000 m = 3; 5000 – 10,000 m = 5; 10,000 – 15,000 m = 7; and distance greater than 15,000 meters away (> 15,000 m = 10). Based on this scheme, the most desirable areas to locate a retail center will be given a weight of 10.

➢ Create a Map of Distance from Existing Retail Centers
- Make the Spatial Analyst toolbar active

- Under the Spatial Analyst drop-down menu choose Options. Under the Extent tab change Analysis Extent to 'Same as layer "Tract_Income"'. Click 'OK'
- Under the Spatial Analyst drop-down menu choose Distance → Straight Line. Change the setting as the following: [Distance to: Existing_Retail_Centers; keep the value for 'Output Cell Size' to be default; specify the 'name' for the output raster and save it to the 'lab 2' folder]. Click 'OK'
- You now have a continuous map of distance from all locations to the existing shops.
- Move the stores theme to the top of the table of contents so that it draws on top of the 'Distance to Existing_Retail_Centers' theme.

** You may change the transparency under the display tap to visual multiple layers**

- ➢ <u>Reclassify the Distance to Existing Retail Centers Theme</u>
- Under the Spatial Analyst drop-down menu choose Reclassify
- The input raster should be 'Distance to Existing_Retail_Centers'
- Click the classify button, under classification change the method to Equal Interval
- Change the number of classes to 5
- Change the method back to Manual
- In the break-values box (on the bottom right side of the window) change the first number to 3000. Change the second number to 5000, the third number to 10000, the forth to 15000, and the last to the biggest value of the distance. Click 'OK'
- In the Reclassify window change the 'new value' next to 0-3000 to 1; next to 3000-5000 to 3; 5000-10,000 to 5; 10,000-15,000 to 7; and the last to 10. Click 'OK'

** These are the suitable areas for the potential shops which you will combine with the demographic data**

<u>MAP Demographical SUITABILITY</u>

Since the Existing Retail Centers location data used in the previous step only tells you the area far from existing shops, you need a demographical map to make sure there is enough potential market in the area. To map the suitability of areas based upon their family income, you will create a tract income map to find out the target market area.

- ➢ <u>Convert Features to Raster</u>
  - Under the Spatial Analyst drop-down menu choose Convert → Features to Raster.
  - The Input Feature is Tract_Income
  - The field is 'INC_MED_FM'
  - Rename this new theme 'Income'
  - Click 'OK'

- ➢ <u>Create a Suitability Map of Income</u>
  - Under the Spatial Analyst drop-down menu choose Reclassify

- Change the input raster to ‘Income’
- Click the Classify button
- Change the method to Equal Interval
- Change the number of classes to 10, and click ‘OK’
- Rename this new theme ‘Reclass of Income’, and then click ‘OK’
- Double click the Reclass of ‘Reclass of Income’ theme to bring up the Layer Properties window; under the Symbology tab choose Classified, change the display of this new theme to graduated color with 10 classes
- Click ‘OK’

<u>MAP TRANSPORTATION LINES DISTANCES</u>

You can not expect customers to visit a new retail center if it is located too far from the main transportation lines. It is best if the location can be next to any main roads or light rail. You would not consider an area if it is further than 10,000 meters from the main roads or light rail.

- <u>Create a Map of Distance from Existing Retail Centers</u>
  - Turn off the display of all layerss except ‘Main_Street’
  - Under the Spatial Analyst drop-down menu choose Distance → Straight Line.
  - Click ‘OK’
  - You now have a continuous map of distance from all locations main roads.
- <u>Reclassify the Distance to Major_Streets Theme</u>
  - Under the Spatial Analyst drop-down menu choose Reclassify
  - The input raster should be ‘Distance to Major_Streets’
  - Click the classify button, under classification change the method to Equal Interval
  - Change the number of classes to 5
  - Change the method back to Manual
  - In the break-values box (on the bottom right side of the window) change the first number to 500. Change the second number to 1000, the third number to 3000, the forth to 10000, and the last to the largest value. Click ‘OK’
  - In the Reclassify window change the ‘new value’ next to 0-500 to 10; next to 500-1000 to 8; 1000-3000 to 5; 3000-10000 to 2; and the last to 0. (Pay Attention: Lower value classes get Higher score in reclassified result) Click ‘OK’

** Here the classes with closer distance get a higher score. This is opposite to the operation on distance to Existing Retail Centers. Why? **

- <u>Same Operation on Light Rail Line</u>

MAP COMPOSITE SUITABLITY

You now have **four** weighted raster grids (two for transportation lines) representing the distance to existing retail centers, high income tracts, and distance from main transportation lines. Because the four resulting grids contain the same weighting scheme, you can now combine them all to create the ranked suitable areas map. Therefore, adding the four grids together, and divide the sum by 4 to achieve a final ranking. (What is meaning of this calculation)

- Turn off the display of all the themes
- Under the Spatial Analyst drop-down menu choose Raster Calculator
- Write this equation into the equation box
([Reclass of Distance to Lightrail_Line] + [Reclass of Distance to Major_Street] + [Reclass of Distance to Existing_Retail_Center] + [Reclass of Income]) / 4

Read this equation, and make sure to understand each element inside

- Click on the Evaluate button
- Double click on the newly created layer to bring up the layer properties box
- Under the symbology tab click classified
- Pick a color ramp and press OK. You will notice that areas with higher values are darker (or lighter, depends on your selection of color ramp) and will be the best sites to locate a new store.

<u>Assignments</u>

- Create your suitability map and then test the sensitivity of the suitability model you created. To do this, change the classification scheme for each criteria, then produce a new suitability map. **Print your original and new suitability map** which should be shown on the same page with a common legend. (Figure out how both themes can be put into one page and share the same legend)
- **Answer the following questions:**
  1. How did you change your classification schemes? What was your reasoning?

  2. Were the changes in suitability significant? Even if they were, did the best (i.e. most suitable) locations for a new store change?

  3. At the final step, the way to composite the final suitability area with four different objects is to sum the four layers up and divided the sum by 4. Do

you think this is a good way to do the composition? If there were problems for such operation, what are they?

4. If you were the owner of these shops, would you bank on the results you obtained? In other words, would you invest in a new store based on your analysis? Why or why not?

Appendix 2

Geography 473
Geographic Information Systems II
Fall 2009

Professor: Alan Murray
T.A.: Yin Liu

Lab #10: Exploratory Data Analysis by Using Geoda

Due: December 1, 2009

In this exercise you will learn to use Geoda software to implement some simple EDA (Exploratory Data Analysis) techniques. Those techniques are some descriptive statistics, which include Histogram, Box Plot, and Scatter Plot. You will also experience a very cool function, "Brushing", which is the animated linking operation, by using Geoda. 1b. v

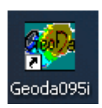
TIP:

- For those who have used Geoda before, especially the function under "Explore" menu, you can directly jump into the assignment part of this lab. However, you can still get assistance from the tutorial material, which introduces all the operations you need to the lab.

This Lab is composed by two parts, the tutorial excursive, which you will learn how to use Geoda with an example data; and the assignment, which you need to practice the operations you learnt from the first part and implement it to a local data.

- **Lab tutorial part:**

By this exercise, you should get familiar the operations of simple EDA techniques in Geoda.

- Open the Geoda, by double click the icon 

on your desktop.
- To get the tutorial material, go to this link via IE or Firefox: http://geodacenter.asu.edu/pdf/geoda093.pdf
(This is the GeoDa User Guide from GeoDa center website. Although it is based on the version 0.9.3, the operations we will use in this lab, based the GeoDa version 0.9.5, are the same with the User Guide)
- **Do page p3~p5**, "Getting Started", to learn how to import file to GeoDa
(You will use 'columbus.shp' from Geoda "sample data" folder. By click "Open Project" icon, the folder should be the default directory. Just in case, the address of the folder is "C:\Program Files\GeoDa\Sample Data")
- Do page **p65~p69**, for operations of "Histogram, Box Plot, and Scatter Plot"; and do page **p70~p76,** for "Linking and Brushing" operations.
(Those tutorials are still based on the 'columbus.shp')

- There is no work to be handed in for the tutorial; however, you must get understand of the operations in the tutorial since there is no operational instruction for the assignment that you need to hand in.

- **Lab assignment part:**

  - The assignment package is at the Blackboard. Download the package and unzip the lab 10 folder.
  - The file you should work on is "**Tract_Income.shp**".
  - Input the "Tract_Income.shp" to Geoda, and work on the field "**INC_MED_HD**", which represents the median household income for each tract.

  - **Hand in:**
    - A report in MS Word or Adobe .pdf; in this report, do some summary of the "**INC_MED_HD**" by your operation on Geoda. This should include at least three statistical graphics, **the histogram, the box plot, and the scatter plot**. Except of the graphics, use your own words to interpret the meaning of the graphics.

    ** Hint: For the scatter plot, you can choose any reasonable field as another variable and explore the relationship between this filed and "**INC_MED_HD**". Explain the reason for your choice of the other variable, and explain the meaning of the scatter plot you create.