Answers: Making Spatial Decisions Using ArcGIS Pro: A Workbook

In this answer guide, the authors have provided sample answers to many of the quantitative questions posed in the book; the answers can vary by 1 percent to 2 percent. The authors have provided images to illustrate some answers, as well as guidance for a couple of the deliverables.
Module 1

Hazardous emergency decisions

Project 1: An explosive situation in Springfield, Virginia

Q2 What is the spatial coordinate system of the project, and is it an appropriate coordinate system for measurements?
   NAD_1983_StatePlane_Virginia_North_FIPS_4501_Feet.

Deliverable 3: An online web map showing critical facilities, traffic patterns, and drive times
Springfield Hazards Evacuation
   http://arcg.is/2len7c4

Project 2: Skirting the spill in Mecklenburg County, North Carolina

Q2 What is the spatial coordinate system of the project?
   NAD_1983_UTM_Zone17N

Q3 How much of the nearby area must be evacuated?
   It has been determined that 15,626 households must be evacuated.
Deliverable 3: An online web map showing critical facilities, traffic patterns, and drive times

Chlorine Spill Mecklenburg, North Carolina

http://arcg.is/2letjk9
Module 2

Hurricane damage decisions

Project 1: Coastal flooding from Hurricane Katrina

Q5 What is the sum of the counts?
   1,295,380

Q6 Complete this table.

<table>
<thead>
<tr>
<th>Type of Land</th>
<th>Percentage</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>9.4%</td>
<td>27,198.7</td>
</tr>
<tr>
<td>Developed</td>
<td>15.3%</td>
<td>44,299.7</td>
</tr>
<tr>
<td>Barren</td>
<td>1.4%</td>
<td>4,031.1</td>
</tr>
<tr>
<td>Forest</td>
<td>11.8%</td>
<td>34,249.0</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6.8%</td>
<td>19,691.5</td>
</tr>
<tr>
<td>Wetlands</td>
<td>55.1%</td>
<td>158,718.5</td>
</tr>
</tbody>
</table>

Hurricane Katrina Damage
   http://arcg.is/2kEF0Ca
Project 2: Hurricane Wilma storm surge

Q5 Complete this table on your worksheet.

<table>
<thead>
<tr>
<th>Type of Land</th>
<th>Percentage</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>9.0%</td>
<td>313.8</td>
</tr>
<tr>
<td>Developed</td>
<td>69.9%</td>
<td>2,410.0</td>
</tr>
<tr>
<td>Barren</td>
<td>2.5%</td>
<td>85.8</td>
</tr>
<tr>
<td>Scrub/Grass</td>
<td>7.2%</td>
<td>253.3</td>
</tr>
<tr>
<td>Wetlands</td>
<td>12.5%</td>
<td>436.4</td>
</tr>
</tbody>
</table>

Key West damage, Hurricane Wilma

http://arcg.is/2lnuAUx
Module 3

Law enforcement decisions

Project 1: Crime in the nation’s capital

Q4 Write a report about the distribution of crime by police district and by the three-minute drive time around the police stations. Describe both the spatial distribution and spatial statistics in your report.

The First, Third, and Second Districts have the highest percentage of crime, with 17 percent, 16 percent, and 15 percent, respectively. The Fourth and Fifth Districts are in the middle, each with 14 percent, and the Sixth and Seventh Districts are the lowest, with 12 percent and 10 percent, respectively.

Q8 Use the hexagon map to look for local variations of high-risk auto theft. Include this information in your report.

The gridded map shows that auto theft is most prevalent in the Third District.

Washington, DC, crime analysis

http://arcg.is/2lnwzs3
Project 2: Analyzing crime in San Diego, California

Q4 Continue your report to the police department by analyzing which transit stations have the most crime reported.

The walk-time areas on the loop on the rail near the water have the most crime. The distribution of the crime is concentric, slowly increasing outward from motor vehicle theft to assault to burglary.

Q5 Incorporate the pattern of distribution of these three crimes (assault, burglary, and motor vehicle theft) in your report.

The gridded map shows a definite concentration of auto theft in the center of San Diego.
Module 4

Composite images

Project 1: Creating multispectral imagery of the Chesapeake Bay

Q5 Write a comparison of the individual objects that can be seen using high-resolution imagery and the lower resolution Landsat. Include possible usages of imagery with different resolutions.

Buildings, highways, and water bodies can be identified using Landsat because of the limited (30 meter) spatial resolution. When you use high-resolution imagery, trees, cars, and other smaller objects can be identified.
Project 2: Multispectral composite bands of the Las Vegas area
Module 5

Calculating unsupervised classification of the Chesapeake Bay
Unsupervised classification

Q7 Describe the difference between the original Reclassed and the post-processed Reclassdmf2bc. Discuss the pros and cons of post-processing.

Post-processing provides a “cleaner” classification, and there are fewer nonclassified pixels. Contiguous patterns are easier to discern. However, post-processing involves changing the values of some pixels, and that introduces the possibility of error.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Water</th>
<th>Developed</th>
<th>Forest</th>
<th>Crop/Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potomac</td>
<td>5.9%</td>
<td>29%</td>
<td>32.1%</td>
<td>33.1%</td>
</tr>
<tr>
<td>Patuxent</td>
<td>5.8%</td>
<td>13.9%</td>
<td>28.7%</td>
<td>22/5%</td>
</tr>
<tr>
<td>Severn</td>
<td>8.5%</td>
<td>8.5%</td>
<td>24.2%</td>
<td>14.5%</td>
</tr>
</tbody>
</table>
Project 2: Calculating unsupervised classification of Las Vegas, Nevada

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Evergreen</th>
<th>Developed</th>
<th>Shrub/Scrub</th>
<th>Barren</th>
</tr>
</thead>
<tbody>
<tr>
<td>Las Vegas Wash</td>
<td>10.1%</td>
<td>4.8%</td>
<td>7.5%</td>
<td>77.6%</td>
</tr>
<tr>
<td>Detrital Wash</td>
<td>7.9%</td>
<td>0%</td>
<td>16.9%</td>
<td>75.2%</td>
</tr>
</tbody>
</table>
Module 6

Supervised classification

Project 1: Calculating supervised classification of the Chesapeake Bay

Q5. Fill in the table with the percentage of each type of land cover in the three watersheds.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Water</th>
<th>Developed</th>
<th>Forest</th>
<th>Crop/Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potomac</td>
<td>3.3%</td>
<td>37.8%</td>
<td>28.3%</td>
<td>30.6%</td>
</tr>
<tr>
<td>Patuxent</td>
<td>4.5%</td>
<td>17.7%</td>
<td>40.3%</td>
<td>37.8%</td>
</tr>
<tr>
<td>Severn</td>
<td>4.5%</td>
<td>31.2%</td>
<td>44.15%</td>
<td>20/1%</td>
</tr>
</tbody>
</table>

Q6. Enter the values in the following chart. You must retrieve the data from module 5 for the unsupervised classification values.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Water Unsup</th>
<th>Water Sup</th>
<th>Developed Unsup</th>
<th>Developed Sup</th>
<th>Forest Unsup</th>
<th>Forest Sup</th>
<th>Crop/Pasture Unsup</th>
<th>Crop/Pasture Sup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potomac</td>
<td>11.6%</td>
<td>3.3%</td>
<td>24.9%</td>
<td>37.8%</td>
<td>46.9%</td>
<td>28.3%</td>
<td>16.6%</td>
<td>30.6%</td>
</tr>
<tr>
<td>Patuxent</td>
<td>16.2%</td>
<td>4.5%</td>
<td>34.7%</td>
<td>17.7%</td>
<td>65.3%</td>
<td>40.3%</td>
<td>23.2%</td>
<td>37.8%</td>
</tr>
<tr>
<td>Severn</td>
<td>20.8%</td>
<td>4.5%</td>
<td>13.9%</td>
<td>31.2%</td>
<td>55%</td>
<td>44.1%</td>
<td>10.2%</td>
<td>20.1%</td>
</tr>
</tbody>
</table>

Potomac, Patuxent, Severn, Watershed

Spatial Reference
Name: NAD 1983 UTM Zone 18N

Map: GoogleEarth

Legend:
- Water
- Developed Land
- Forest
- Crop/Pasture

<table>
<thead>
<tr>
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<th>Water</th>
<th>Developed</th>
<th>Forest</th>
<th>Crop/Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severn</td>
<td>55%</td>
<td>44.1%</td>
<td>10.2%</td>
<td>20.1%</td>
</tr>
</tbody>
</table>
Project 2: Calculating supervised classification of Las Vegas, Nevada

Q5 Complete this table.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Evergreen</th>
<th>Developed</th>
<th>Shrub/Scrub</th>
<th>Barren</th>
</tr>
</thead>
<tbody>
<tr>
<td>Las Vegas Wash</td>
<td>11.6%</td>
<td>20.1%</td>
<td>23.3%</td>
<td>45%</td>
</tr>
<tr>
<td>Detrital Wash</td>
<td>11.2%</td>
<td>15.2%</td>
<td>15%</td>
<td>58.6%</td>
</tr>
</tbody>
</table>

Q6 Enter the values in the following chart. You must retrieve the unsupervised values from module 5.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Evergreen Unsup</th>
<th>Evergreen Sup</th>
<th>Developed Unsup</th>
<th>Developed Sup</th>
<th>Shrub/Scrub Unsup</th>
<th>Shrub/Scrub Sup</th>
<th>Barren Unsup</th>
<th>Barren Sup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Las Vegas Wash</td>
<td>10.1%</td>
<td>11.6%</td>
<td>4.8%</td>
<td>20.1%</td>
<td>7.5%</td>
<td>23.3%</td>
<td>77.6%</td>
<td>45%</td>
</tr>
<tr>
<td>Detrital Wash</td>
<td>7.9%</td>
<td>11.2%</td>
<td>0%</td>
<td>15.2%</td>
<td>16.9%</td>
<td>15%</td>
<td>75.2%</td>
<td>58.6%</td>
</tr>
</tbody>
</table>
Module 7
Basic lidar skills

Project 1: Basic lidar skills using Baltimore, Maryland, data

Q3 What is the range of elevation?
The range of elevation is −288.87 to 416.86 feet.

Q6 Write a brief paragraph about the data, including the number of points, vertical unit, spatial reference, classification codes, and return values.

There are 3,566,042 points with a vertical unit of feet. The spatial reference is NAD 1983 StatePlane Maryland FIPS 1900 Feet. The classification codes are Class 1–Unassigned, Class 2–Ground, Class 7–Noise, Class 12–Overlap, and Class 18–Outliers. The return values are first through fifth return.
Project 2: San Francisco, California

Q3 What is the range of elevation?
   The range of elevation is 35.28 to 263.98 meters.

Q6 Write a brief paragraph describing the data, including the number of points, the vertical unit, the spatial reference, classification codes, and return values.
   There are 4,290,588 points with a vertical unit of meters. The spatial reference is NAD 1983 UTM Zone 10N. The classification codes are Class 1–Unassigned, Class 2–Ground, Class 7–Noise, Class 9–Water, and Class 10–Reserved. The returns are first through fourth return.
Module 8

Location of solar panels

Project 1: James Madison University, Harrisonburg, Virginia

Q3 Which areas would be the best for installing solar panels? The red areas? The blue areas?

The red areas would be the best place to install the solar panels.
Project 2: University of San Francisco, San Francisco, California

Q3 Judging by the solar insolation display, which areas would receive the maximum insolation for solar panel placement?

The red areas would receive the maximum insolation for the solar panel placement.
Module 9

Forest vegetation height

Project 1: George Washington National Forest, Virginia

Q3 What is the town’s location relative to GWNF? What is to the east? To the south?
   The town of Harrisonburg is to the east, and Staunton is to the south.

Q5 What is the unit for Elevation, and what are the lowest and highest elevations represented in the DEM?
   The highest elevation of the DEM is 3,226.92 feet, and the lowest elevation is 1,569.55 feet.

Q7 What is the unit for Elevation, and what are the lowest and highest elevations represented in the DSM?
   The highest elevation of the DSM is 3,226 feet, and the lowest elevation is 1,622 feet.

Q8 What are the lowest and highest values in the height raster?
   The lowest elevation in the height raster is −6 feet, and the highest is 1,270 feet.

Q9 How many cells have a value of over 196 feet?
   There are six cells with a value of over 196 feet.
Q10 How many cells have a value of less than 0?
There are 836 cells with a value of less than 0.

Project 2: Michaux State Forest, Pennsylvania

Q3 In what range of mountains is the LAS data frame located?
The LAS data is in the Piney Mountains.

Q5 What are the lowest and highest values in the height raster?
The lowest elevation is 6 feet, and the highest is 1,260 feet.

Q6 How many cells have a value of over 196 feet?
Three cells have a value of over 196 ft.

**Q7 How many cells have a value of less than 0?**
There are 11,455 cells with a value of less than 0.

**Q8 Describe the distribution of the cells that are less than 0.**
The cells less than 0 seem to be random.