1. The forces that determine the size of groups ("swarms") of social insects and the rates at which they grow are not well understood. Biologists have observed large variability in the size of colonies across species. In a study of the social wasp, *Polybia occidentalis*, investigators dismantled a nest of these insects and marked a few insects for future identification in new swarms. Twenty-five days after dismantling the original swarm they had located new swarms of wasps from the original colonies. The data below present the numbers of adults and workers in the new colonies. (The study was replicated in two different years.) "Drones" are fertile males that mate with the queen. "Workers" are infertile females that labor in the nest and defend the colony.

Adults and Workers
Swarm size in first and second surveys

First Year Swarm Colony #	Drones	Workers		Second Year Swarm Colony #	Drones	Workers
1	598	597		1	355	339
2	24	21		2	691	673
3	567	557		3	278	252
4	371	325		4	719	669
5	279	260		5	152	129
6	44	35		6	156	140
7	42	41		7	41	35
8	126	107				
9	108	101				
10	79	64				

(a) Construct a comparative (back to back) stem-and-leaf display of the numbers of <u>drones</u> in the swarms in the first and second years.

(b)   Using your plot in part (a), compare the distributions of the numbers of drones in the first and second year colonies, noting any interesting features of the distributions.

2. Higher vertebrates – mammals and birds – exhibit lateralized behaviors, commonly referred to as "handedness."   Recently an investigator studied the coiling behavior of the *Agkistrodon piscivorus leucostoma* – more commonly known as the cottonmouth. The cottonmouth is a venomous snake that spends much of its time in coils, sometimes coiled in a counter-clockwise direction, other times in a clockwise direction.   The investigator made many observations of coiling behavior over 6-month times, and calculated a "laterality index" for 30 cottonmouths. Data on the laterality index for these cottonmouths is presented below.

Laterality Index (% coils counterclockwise)

58	55	60	51	56	49
59	54	70	56	56	49
55	60	42	57	52	48
55	64	49	42	54	46
61	66	49	43	40	49

(a)   Construct a stem-and-leaf display of the laterality indices for these snakes.

(b)   In a few sentences describe the distribution of laterality indices.

In the table below the data on laterality has been separated into two groups: juvenile and adult snakes.

Laterality: Adults

58	55	61	54	64	60	42	49	56	54
59	55	55	60	66	70	49	56	52	40

Laterality: Juveniles

58	55	61	54	64	60	42	49	56	54

(c) Using the same scale, construct a box plot of the laterality indices of adult cottonmouths and a boxplot of the laterality indices of and juvenile cottonmouths.

Adult

Juvenile

(d) Using your box plots from part (a), compare the distributions of laterality for adults and juveniles. Justify your comparisons by appealing to specific aspects of the box plots in part c.

3. A wide variety of oak trees grow in the United States. In one study a sample of acorns was collected from different locations, and their volumes, in cm^3, were recorded. The table at right presents summary statistics for these data.

Acorn Statistics

Statisctic	Value
N	38
Mean	3.0
Median	1.8
St. Dev.	2.6
Minimum	0.3
Maximum	10.5
1st Quartile	1.1
3rd Quartile	4.3

(a) Describe a ***procedure*** that uses these some or all of these summary statistics to determine whether outliers are present in the data.

(b) Using your procedure from part (a), determine if there are outliers in these data.