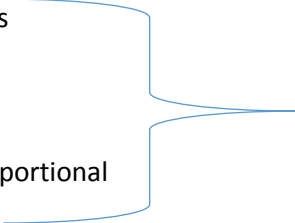


Data Analysis: Brain and body size in mammals

Necessary background information

- 1) Scatter plots
 - 2) Best fit line
 - 3) Correlation
 - 4) Proportions
 - 5) Directly proportional
 - 6) R value
 - 7) Functions of the cerebral cortex and cerebellum (Notes Question #43: How does the brain handle complex and simple tasks?)
- Scatter plots and regression analysis assignment
- 

- 1) What are the functions of the cerebral cortex?

- 2) What are the functions of the cerebellum?

The cerebral cortex

The cerebral cortex forms a larger proportion of the brain and is more highly developed in humans than other animals.

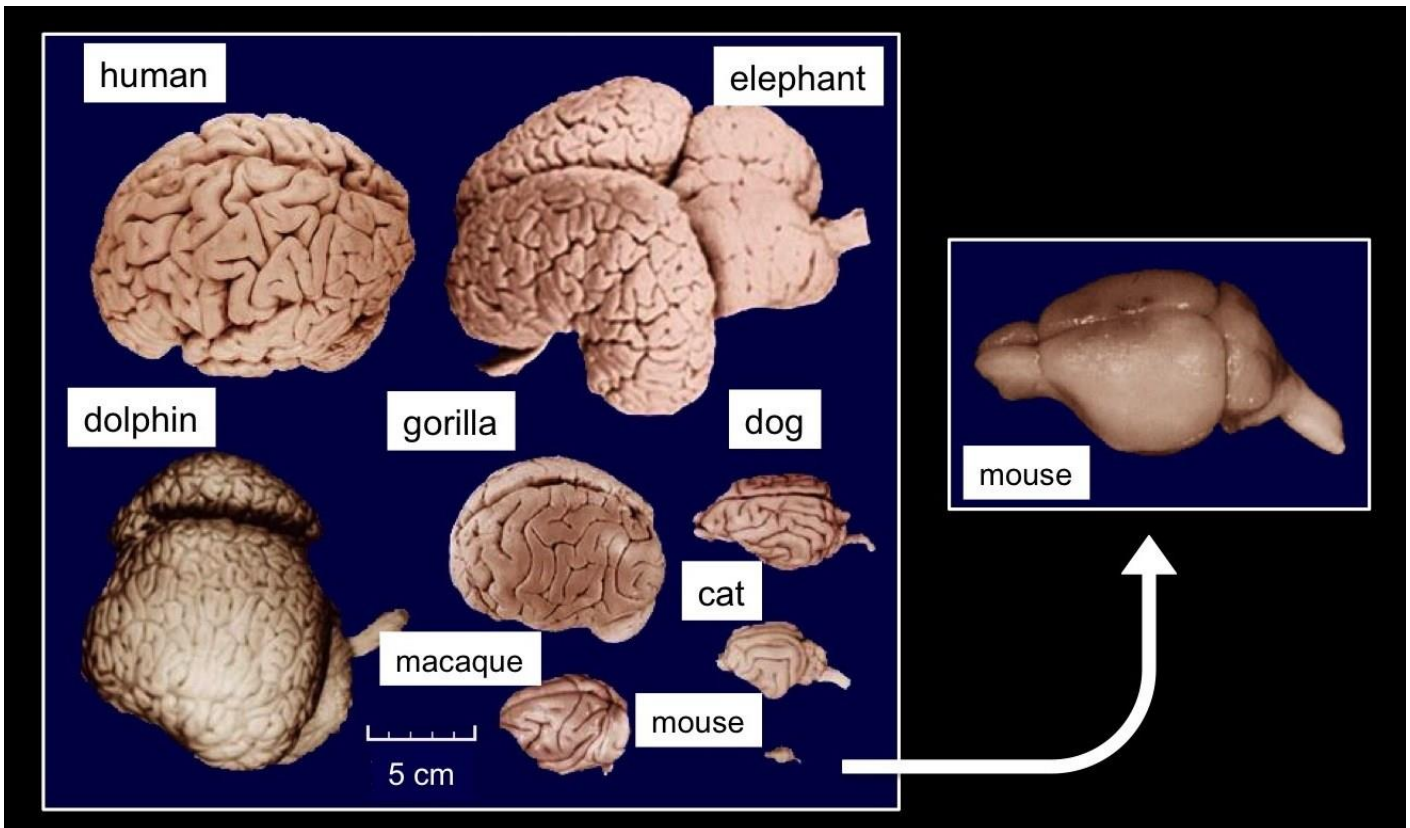
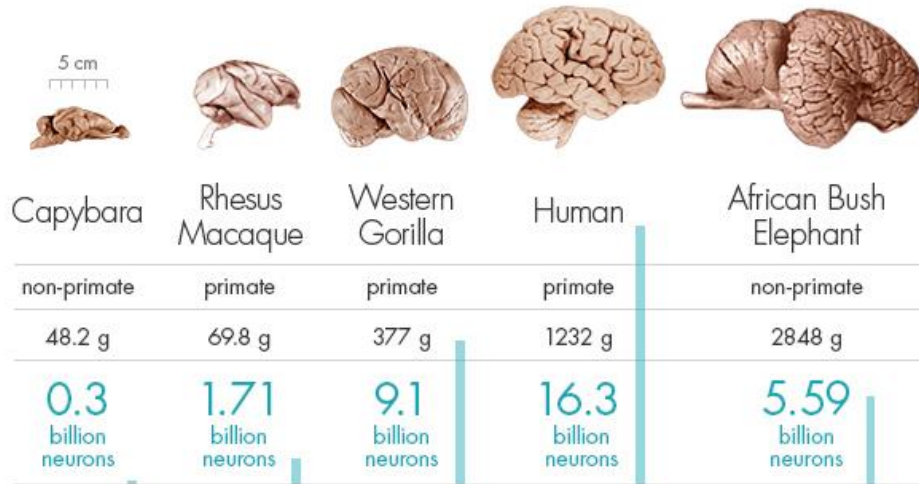
The cerebral cortex is the outer layer of the cerebral hemispheres. Although it is only two to four millimeters thick, up to six distinctively different layers of neurons can be identified in sections studied under a microscope. It has a highly complex architecture of neurons and processes the most complex tasks in the brain.

Only mammals have a cerebral cortex. Birds and reptiles have regions of the brain that perform a similar range of functions but they are structurally different, with cells arranged in clusters rather than layers. Among the mammals, the cerebral cortex varies in size considerably. In humans, it forms a larger proportion of the brain than in any other mammal.

The evolution of the cerebral cortex

BRAIN SIZE AND NEURON COUNT

Cerebral cortex mass and neuron count for various mammals.



The human cerebral cortex has become enlarged principally by an increase in total area with extensive folding to accommodate it within the cranium.

The cerebral cortex has become greatly enlarged during human evolution, and now contains more neurons than that of any other animal. There has been a modest increase in thickness, but the cortex is still only a few millimeters thick. The increase is due principally to an increase in total area and that necessitates the cortex becoming extensively folded during development. It is hard to measure, but the area is estimated to be about 180,000 mm² or 0.18 m². This is so large that the brain can only be accommodated inside a greatly enlarged cranium, forming the distinctive shape of the human skull.

Most of the surface area of the cerebral cortex is in the folds rather than on the outer surface. In contrast, mice and rats have an unfolded smooth cortex. But in cats there are some folds and elephants and dolphins have more. Among the primates, monkeys and apes show a range of cortex size and degree of folding, with larger sizes in primates that are more closely related to humans.

- 1) Where is the cerebral cortex located?

- 2) Describe the cerebral cortex

- 3) What kind of animal has a cerebral cortex?

- 4) What does the statement "In humans the cerebral cortex forms a larger proportion of the brain than in any other mammal" mean?

- 5) How has the cerebral cortex increased in size in humans?

- 6) Compare the folding of the cerebral cortex among the mammals shown above

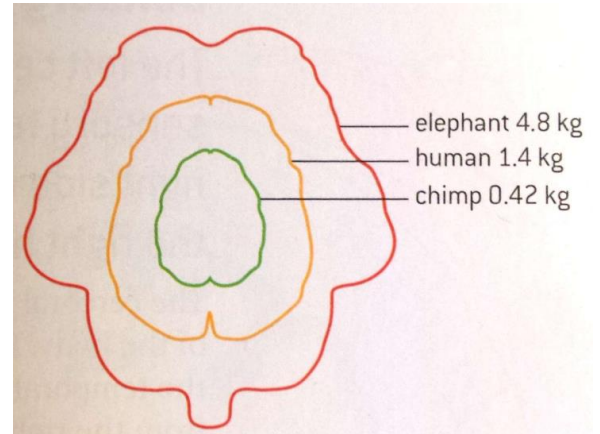
- 7) Compare the visible brain organs among the mammals shown above

Comparing brain size

Analysis of correlations between body size and brain size in different animals.

Scatter plots show a positive correlation between body size and brain size in animals, but that the relationship is not directly proportional. The data based questions below can be used to develop your skill in analyzing this type of data.

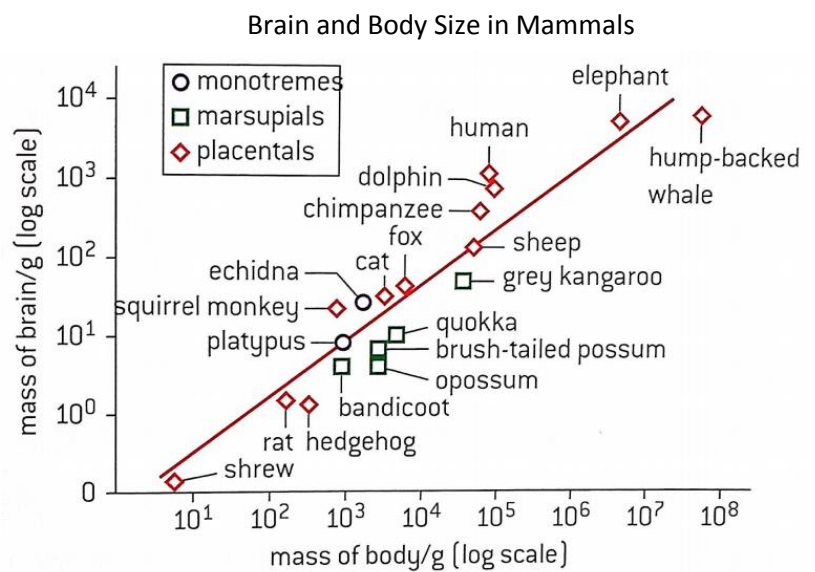
The scatter plots in figure 5 show the relationship between brain and body mass in species of placental, marsupial and monotreme mammal.



8) State the relationship between brain and body mass.

9) Explain how the points on the scatter plot would have been arranged if brain mass was directly proportional to body mass ($r=1$).

10) If the body mass to brain size of an organism is on the line, what can you say about the relative brain size of the animal?



▲ Figure 5

11) If the body mass to brain size of an organism is above the line, what can you say about the relative brain size of the animal?

12) If the body mass to brain size of an organism is below the line, what can you say about the relative brain size of the animal?

13) Compare the brain sizes of placental mammals and marsupial mammals

14) Suggest a reason for the researchers not including more data for monotremes in the scatter plot.

15) Which animal is the most intelligent?

16) Justify your answer to the last question using the scatter graph, the pictures of mammal brains above, and the reading about the cerebral cortex and the evolution of the cerebral cortex. A justification has 3 components: 1) Scientific knowledge or theory, 2) data from your analysis that is related to the knowledge, and 3) an explanation of HOW the analysis supports the knowledge.