Statistics with Recitation — Quiz 2

October 7, 2025

Answer Key

1. (**18 points**) A power bank's total available charge (in mAh) is denoted by X. A single phone charge uses a random amount of charge denoted by Y. Different power banks and phone charges vary slightly. Assume all quantities mentioned below are independent, and different phone charges are i.i.d. copies of Y.

	mean	SD	variance
X	10000	400	160000
Y	2000	300	90000

   (a) (**6 points**) One full power bank, plus *four* single-phone charges from a second power bank, are used during a trip. What is the expected total charge delivered? What is its standard deviation?

   (b) (**6 points**) How much charge would you expect to be left in a power bank after one phone charge? That is, find $\mathbb{E}[X - Y]$. What is the standard deviation of the remaining charge?

   (c) (**6 points**) Using this context, explain why *variances* add even when we subtract one random variable from another (e.g., $\mathrm{Var}(X - Y) = \mathrm{Var}(X) + \mathrm{Var}(Y)$).

2. (**12 points**) Thalassemia is an autosomal recessive blood disorder. If both parents are carriers, each child has a 25% chance of having the disease, a 50% chance of being a carrier, and a 25% chance of being neither affected nor a carrier. Suppose two carrier parents have *four* children. Find the probability that

   (a) (**3 points**) none will have the disease;

   (b) (**3 points**) exactly one child will have the disease;

   (c) (**3 points**) at least one child will be neither affected nor a carrier;

   (d) (**3 points**) the first child with the disease will be the 4th child.