**APEC Math Review - Day 2 exercises**

1. Let a collection of commodities vectors be given as:

You can view commodities as food, clothing, entertainment etc. Each will have multiple elements, for instance food may contain dairy, candy, fresh fruits, and so on. We can call an element of this set as a “bundle.” One property of the consumption set is that it is convex.

Let price be and wealth be . Define this person’s budget set as: . Show that this budget set is convex. (*Hint: use the fact that you know that the consumption set is convex to begin with*).

1. Prove that when is a convergent sequence of numbers in , its limit is unique.
2. Bonus: prove that when is a convergent sequence of elements in a metric space, its limit is unique.
3. Walras’ Law is a fundamental result in consumer theory. Walras’ Law says that under standard conditions on preferences, consumers will choose a consumption bundle on their budget constraint, i.e., they will spend all their money.

Formally: Consider a consumer with locally nonsatiated preferences, and let x\* be their optimal consumption bundle, p a vector of fixed prices, and W their wealth. Then .

This requires a definition of locally nonsatiated, which is:

A consumer’s preferences over consumption set X are considered locally nonsatiated if , every open ball around x contains a bundle that is strictly preferred to x.

Prove Walras’ Law.