

# Module 1: Health Insurance

## Insurance and risk

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Econ 372

# Warmup

Let's start with our in-class quiz from last week (that I forgot to do)

# Humana exits the ACA exchanges

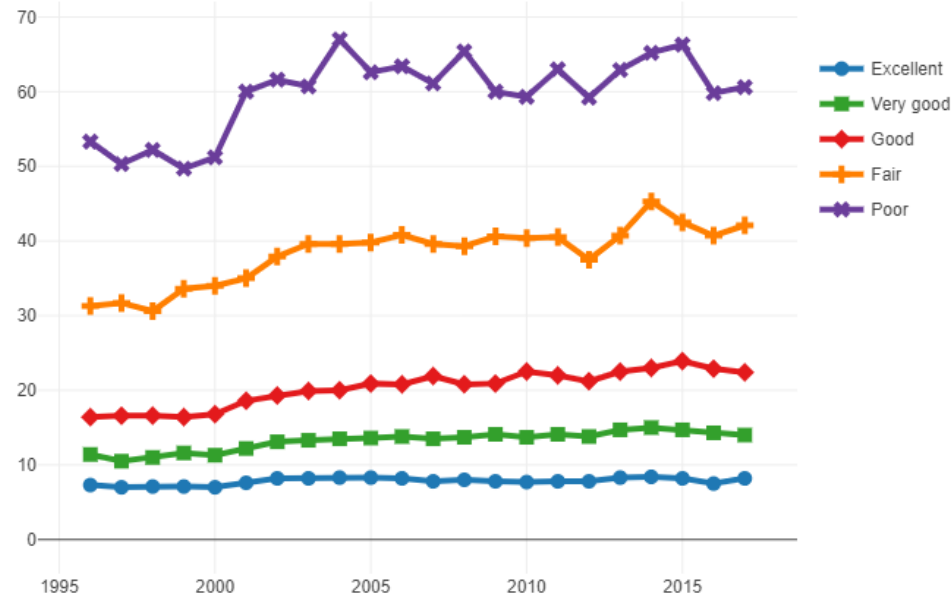
In 2018, Humana exited the ACA exchanges due to an "unbalanced risk pool based on the results of the 2017 open enrollment period". [CNN Money Article](#)

- What do you think this means?
- What is the underlying business reason here?

Fun fact: Humana and Aetna's merger deal had just been blocked. [NPR Article](#)

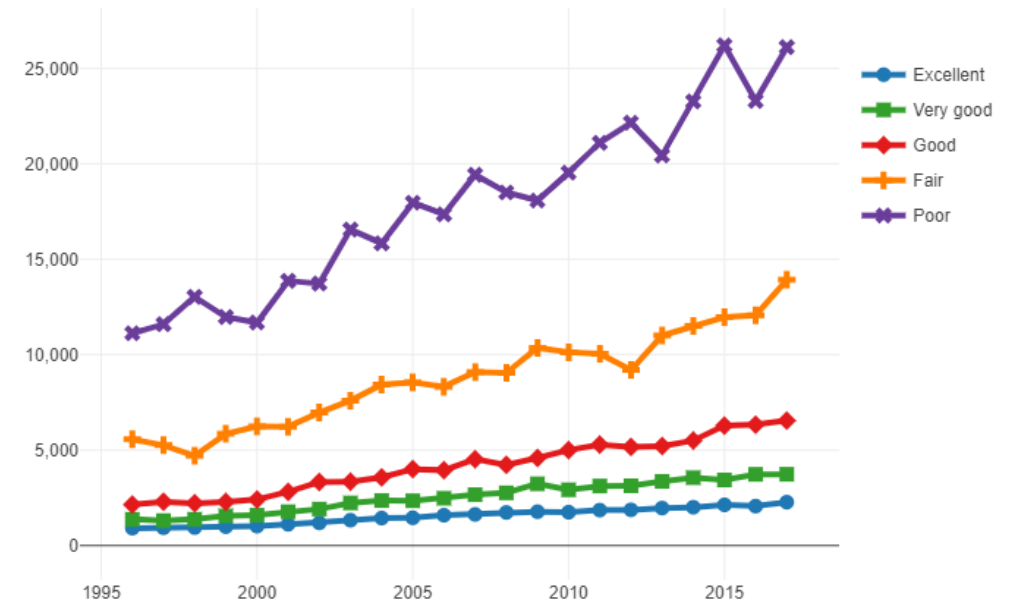
# Managing risk is really important

Mean events per person by perceived health status, United States, 1996-2017



Source: Center for Financing, Access and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1996-2017

Mean expenditure per person by perceived health status, United States, 1996-2017



Source: Center for Financing, Access and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1996-2017

# Insurance and Risk

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# Describing risk

We need three things to define risk in this class:

1. Probability
2. Expected value
3. Preferences (i.e., a utility function)

# 1. Probability

Definition: The likelihood that a given outcome will occur.

Important to note the timing here...probability applies to an uncertain event that may have several possible outcomes. For example, I may have a heart attack or I may not. [Risk Calculator](#).

## 2. Expected value

Definition: The probability weighted average of the payoffs (or costs) associated with all possible outcomes.

For two potential outcomes,  $x_1$  and  $x_2$ , with probabilities  $p_1$  and  $p_2$ :

$$E[x] = p_1 x_1 + p_2 x_2$$



# Example

What is my expected cost?

- Two possible outcomes: heart attack or no heart attack
- 10% chance of having a heart attack
- Cost of \$100,000 if I have a heart attack (but I will survive and recover)

# Answer

I will incur a cost of \$100,000 with 10% probability. So my expected cost is just  $E[\textit{cost}] = 0.1 * 100,000 = 10,000$ .

### 3. Preferences

Definition: Preferences take the form of a utility function,  $u(\mathbf{x})$ , which tells us how much we benefit get from some consumption bundle,  $\mathbf{x}$ .

Expected utility the combines expected value and utility...

$$E[u(\mathbf{x})] = p_1 u(\mathbf{x}_1) + p_2 u(\mathbf{x}_2)$$

# Risk preferences

With probabilities, expected values, and utilities/preferences, we can now measure preferences toward risk.

- **Risk averse:** We prefer to avoid the risky situation. You would rather have the same (or slightly less) with certainty than a lottery over two risky outcomes.
- **Risk neutral:** Indifferent between the risky situation or that of certainty.
- **Risk loving:** Prefer the risky situation.

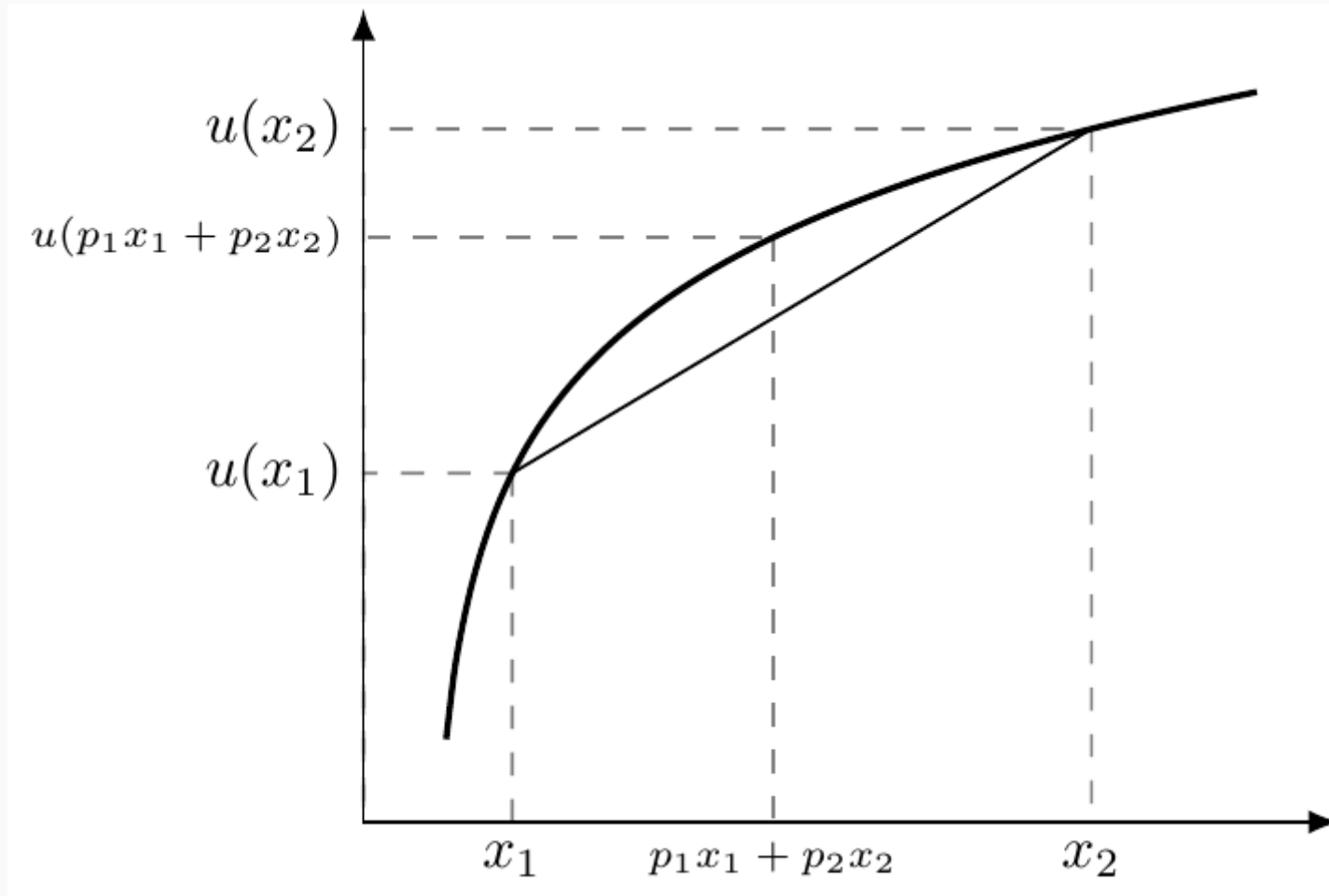
# Risk aversion

Most common assumption is that individuals are risk averse. Mathematically, this follows from diminishing marginal utility.

$$u'(x_1) > u'(x_2) \text{ for } x_1 < x_2$$

What does this mean in words?

# Risk aversion



# In-class Problem: Expected values

An individual starts with a wealth of \$100,000. With probability 0.3, they will get sick and incur a cost of \$40,000.

1. What is this person's expected cost of illness?
2. Assume this individual has a utility function of the form,  $u(w) = w^{0.20}$ . What is this person's expected utility?
3. Calculate this person's utility if they were to incur the cost of illness with certainty. Is this utility higher or lower than what you found in part (2)?