Risk Preferences

PROSPECT THEORY II: LOSS AVERSION

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Recap

Suppose you have initial wealth w,
Consider lotteries $X = (x, p; 0, 1 - p)$, i.e. $X = (x, p)$
How will you evaluate lottery X ?

Expected Value Theory

Expected Utility Theory

Prospect theory

, $v(.)$ at the reference point is usually normalized to 0.

Recap

Suppose you have initial wealth w,
Consider two lotteries $X = (x, p; 0, 1 - p)$ and $\mathrm{Y} = (y, q; 0, 1 - q)$
You will prefer lottery X over lottery Y IF….

Expected Value Theory

Expected Utility Theory

Prospect theory

Expected Utility Theory

Let w be a person's wealth

Let $X \equiv (x_1, p_1; \dots; x_n p_n)$ be a risky prospect, which yields income x_i with probability p_i

EU theory says that prospect X can be evaluated according to utility function

$$U(X; w) = p_1 u(w + x_1) + \cdots + p_n u(w + x_n)$$

For example, for prospect $(x, p; y, q)$,

$$U(x, p; y, q) = pu(w + x) + qu(w + y) + (1 - p - q)u(w)$$

We choose prospect X over prospect Y if

$$U(X; w) > U(Y; w).$$

Prospect theory

Kahneman & Tversky (1979) develop a new theory, Prospect Theory, to incorporate these observed behaviors.

Some key features they emphasize in their model:

- Evaluation of choices are made relative to a reference point.
- Diminishing sensitivity (risk-averse in gains, risk-loving in losses)
- Loss Aversion
- Probability weighting

Prospect Theory: Editing Stage

organize & reformulate the problem

What is going on in editing stage? Taking an objective prospect $(\hat{x}_1, \hat{p}_1; \ldots; \hat{x}_m, \hat{p}_m)$and transforming it into an object for evaluation $(x_1, p_1; \ldots; x_n, p_n)$ by:

- ________________: code outcomes as gains & losses relative to reference point.
- _________________: e.g., (100, .5; 100, .5) replaced with (100, 1).
- _________________: e.g., (100, .5; 200, .5) replaced with 100 for sure plus (0, .5; 100, .5).
- __________________: discard shared components.
- __________________: rounding of probabilities.
- Eliminating dominated alternatives.

Prospect theory: Evaluation stage

A prospect can be written as $(x, p; y, q)$ with $p + q \leq 1$.

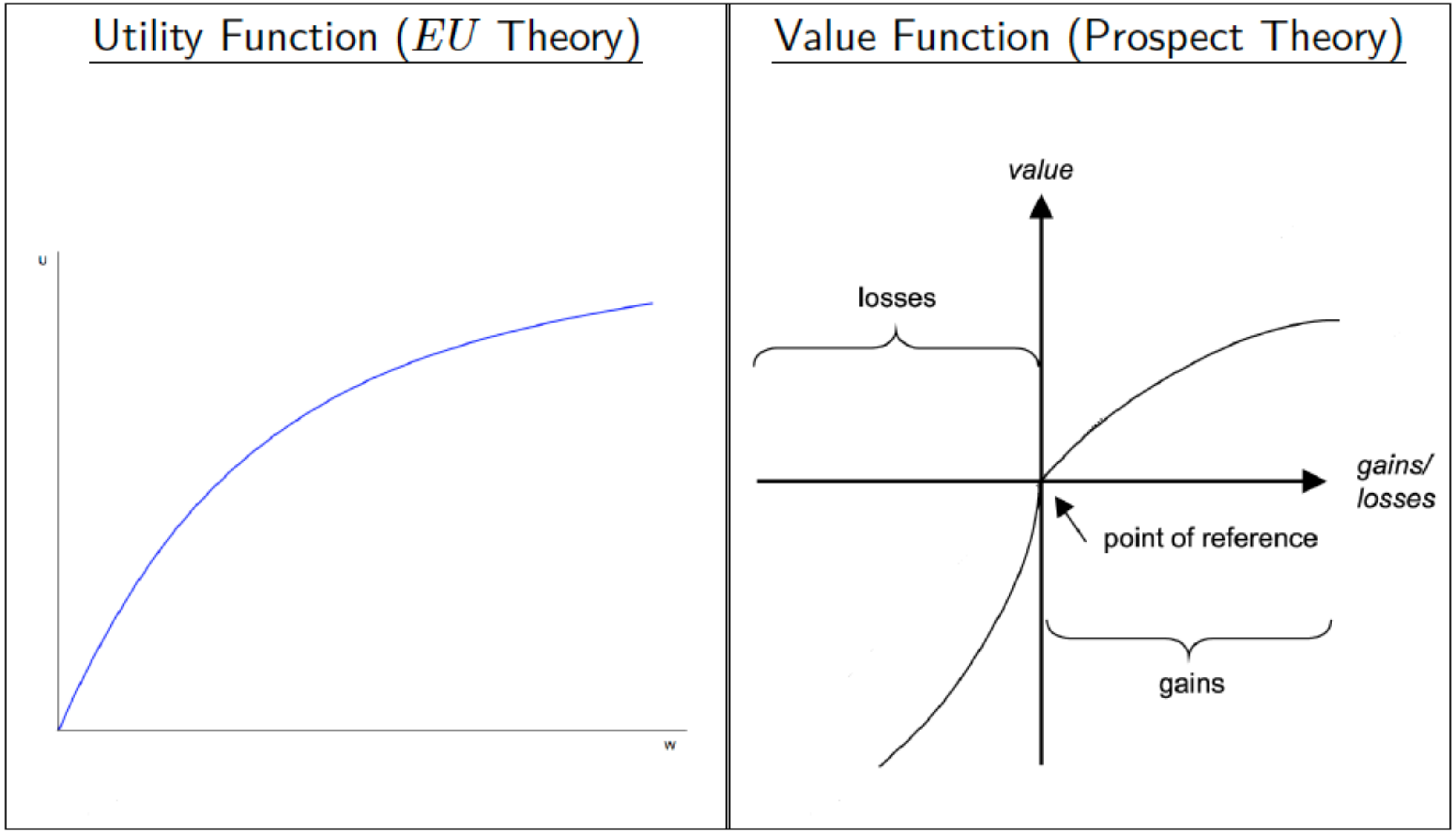
Note: $p + q < 1$ implies prospect yields 0 with probability $1 - p - q$.

A person evaluates a prospect $(x, p; y, q)$ according to the functional

$V(x, p; y, q) = \pi(p)v(x) + \pi(q)v(y)$

Note: Nowadays, it might be best to take Prospect theory as a theory for simple prospects with at most two non-zero outcomes.

Utility function vs. Value function



Prospect Theory: Value Function

Three key features of the value function $v(.)$:

- The carriers of value are changes in wealth ($v(.) = 0$).
- Diminishing sensitivity to the magnitude of changes:

(____________________________________).

- Loss aversion: losses loom larger than gains.

$\frac{v'(x)\ when\ x<0}{v'(x)\ when\ x>0} > 0$, or $(\mathrm{y}, 0.5; -\mathrm{y}, 0.5) \succ (x, 0.5; -x, 0.5)$ if $0 < y < x$

Prospect Theory: Value Function

Two common functional forms for the value function:

Tversky & Kahneman (1992)

$v(x) =$,where $\alpha, \beta \in (0,1]$ and $\lambda \geq 1$

Two-part linear

$$v(x) = \begin{cases} x & if\ x > 0 \\ -\lambda x. & if\ x < 0 \end{cases}$$,where $\lambda \geq 1$

λ is the coefficient of loss aversion.

Prospect Theory: Value Function Measuring Loss Aversion

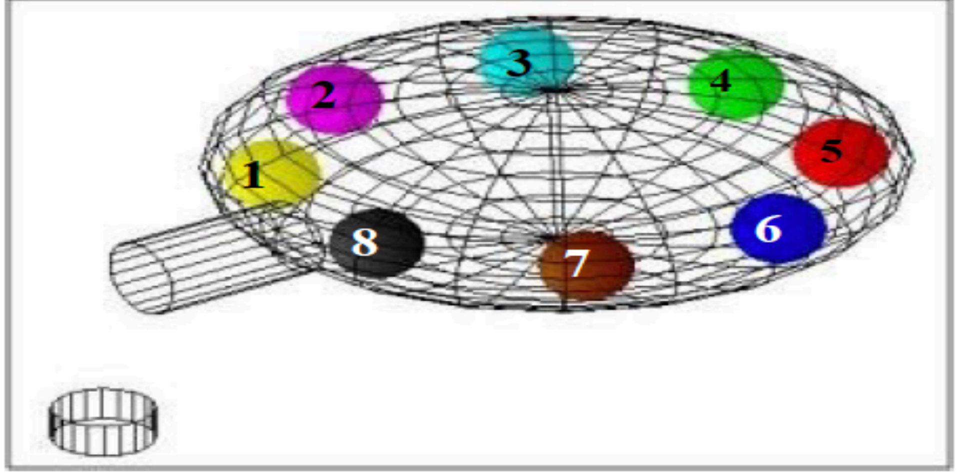
How loss averse is the average person?

Would you accept the following bet? A coin toss where:

If tails, lose \$100, heads win \$150?

If tails, lose \$100, heads win \$160?

If tails, lose \$100, heads win \$170? …



Win € 20 if one of the following balls is extracted:

1 2 3 4

If one of the following balls is extracted, then:

5 6 7 8

Lose € 20	O	O	€ 0 for sure
Lose € 19	O	O	€ 0 for sure
Lose € 18	O	O	€ 0 for sure
Lose € 17	O	O	€ 0 for sure
Lose € 16	O	O	€ 0 for sure
Lose € 15	O	O	€ 0 for sure
Lose € 14	O	O	€ 0 for sure
Lose € 13	O	O	€ 0 for sure
Lose € 12	O	O	€ 0 for sure
Lose € 11	O	O	€ 0 for sure
Lose € 10	O	O	€ 0 for sure

Prospect Theory: Value Function
Measuring Loss Aversion

The coefficient of loss aversion is______________________________

____

For coin toss above, typical response is to be indifferent at gain = $200

Loss aversion coefficient or ratio is generally found in range 1.5 to 2.5.

Willingness to Pay(WTP) vs. Willingness to Accept(WTA)

Around the same time Kahneman and Tversky were working on their model of Prospect Theory, economist Richard Thaler was noticing (and writing about) some of his own "anomalies"...

- Standard economic theory says that an individual has a single value (i.e. some price p) that they associate with any good

  - If they are given the opportunity to buy the good at (__________) that price, they'll pay it
  - Similarly, if someone offers to buy the good from them at (__________) that price, they'll accept it

- In reality, we often observe behavior that suggests otherwise...

Willingness to Pay(WTP) vs. Willingness to Accept(WTA)

Example 1: Thaler's professor was a wine collector who frequently shopped at wine auctions

- He never paid more than $35 for a bottle ("willingness to pay")
- ...but he never sold them for less than $100 ("willingness to accept")

Example 2: You buy a ticket to see Chelsea at Stamford Bridge, and you pay the face value ($300) for your ticket

- You would have actually paid up to $500 (WTP)
- ...but you wouldn't sell the ticket online for less than $1000 (WTA)

The Endowment Effect

Why the gap between willingness to pay and willingness to accept?

Thaler (1980) attributes gap to what he coined_____________.

"People tend to value an object _________________________than when they do not."

- Originally modeled as an extra utility gain from having/owning an object (rather than getting/receiving an object) – individuals value an object more when they own it
- Related to loss aversion – the________________________ is larger than the utility from receiving that same item

Endowment Effect: Mug Experiment

Kahneman, Knetsch, and Thaler (1990) test these ideas in their famous “mug experiments” at Cornell University.

Typical Experiment: Class of 50 - 75 economics students.

After students sit down, half of them are given a coffee mug.

Endowment Effect: Mug Experiment
Design

Potential "Sellers"	Potential Buyers
How much willing to accept for the mug?	How much willing to pay for the mug?

If there is a________________________ in the group, they trade.

Endowment Effect: Mug Experiment
Prediction

What does standard economic theory predict? How many will trade?

When markets clear, mugs will be owned by those who value them the most

Since mugs were assigned at random, on average:

- WTP = WTA
- If roughly half of “mug lovers” have mugs, and half don’t
- Then about half of the mugs should trade

Endowment Effect: Mug Experiment
Result

- Cornell bookstore price is $6.00 for the mug
- Students might value the mug more or less than this price, but standard theory says that, on average, we should find WTP = WTA
- Results:

Buyers: (median) WTP = $2.25

Sellers: (median) WTA = $5.75

Even for goods they just received (and didn't necessarily want),

This was claimed as an endowment effect.

Endowment Effect: Mug Experiment
Result

- Add a “Chooser” group: elicit the amount of money at which they would be indifferent between receiving a mug and receiving the money

  Choices:

  Sellers: (mug, $0) vs. (no mug, $5)

  Buyers: (mug, -$5) vs. (no mug, $0)

  Choosers:___________________________

- But sellers and choosers have the exact same choice!

Endowment Effect: Mug Experiment
Result

- Add a “Chooser” group: elicit the amount of money at which they would be indifferent between receiving a mug and receiving the money

  Results:

  Sellers: $7.12

  Buyers: $2.87

  Choosers: $3.12

- But sellers and choosers have the exact same choice!

Endowment Effect: Mug Experiment
Robustness check

- Different products: chocolate bars, pens, “folding binoculars in a cardboard frame”

- Subjects can be endowed with either: {mug, candy, choice}

(i) Endowed with mug >> 89% choose mugs

(ii) Endowed with candy >> 10% choose mugs

(iii) Choosers >> 56% choose mugs

A more general overall utility function:

- x is final consumption, r is the reference point
- $u(x)$ is intrinsic utility from consumption ("standard economic utility")
- $v(x - r)$ is gain-loss utility

A Simple Model of Loss Aversion & the Endowment Effect

Assume preferences described by

Assume $r \in \{0, 1\}$

- $r = 0 \iff$ unendowed (buyers and choosers)
- $r = 1 \iff$ endowed (sellers)

Assume $c \in \{0, 1\}$

- $c = 1 \iff$ go home with mug (buy, choose, or keep).
- $c = 0 \iff$ go home without mug (don't buy, don't choose, or sell)

A Simple Model of Loss Aversion & the Endowment Effect

Assume $u(c|r) =$

	$r = 0$	$r = 1$
$c = 0$	0	$-\lambda\phi$
$c = 1$	$\mu + \phi$	μ

Note: Loss aversion means $\lambda > 1$.

Loss aversion and endowment effect

Given wealth w and price p:

Sellers sell if:

____________________________, where $-\lambda\phi$ is mug utility, and $w + p$ is money utility

____

Buyers buy if:

____________________________,

____

Coefficient of Loss Aversion
Measurement

- Earlier, we measured the coefficient of loss aversion from answers to whether you would accept a bet with a 50% chance to win X , and a 50% chance to lose Y , where:

Coefficient of Loss Aversion =____

- We can also measure the coefficient of loss aversion using the endowment effect experiment:

Coefficient of Loss Aversion =__________________________

Using data from the experiments above =5.75/2.25 = 2.6

Evidence of Loss Aversion in the Field

Thus far, we've focused on documenting evidence of loss aversion in laboratory experiments

- Bets with 50% chance to win X and 50% chance to lose Y
- Endowment effect w/ mugs & candy

Do we find any evidence of loss aversion in the field (i.e., the real world)?

- We are often interested in whether behavior persists with "real stakes" (i.e., when the outcome really matters), e.g. marathon runners & college admissions

Allen, Dechow, Pope & Wu (2014): Reference-Dependent Preferences, Evidence from Marathon Runners

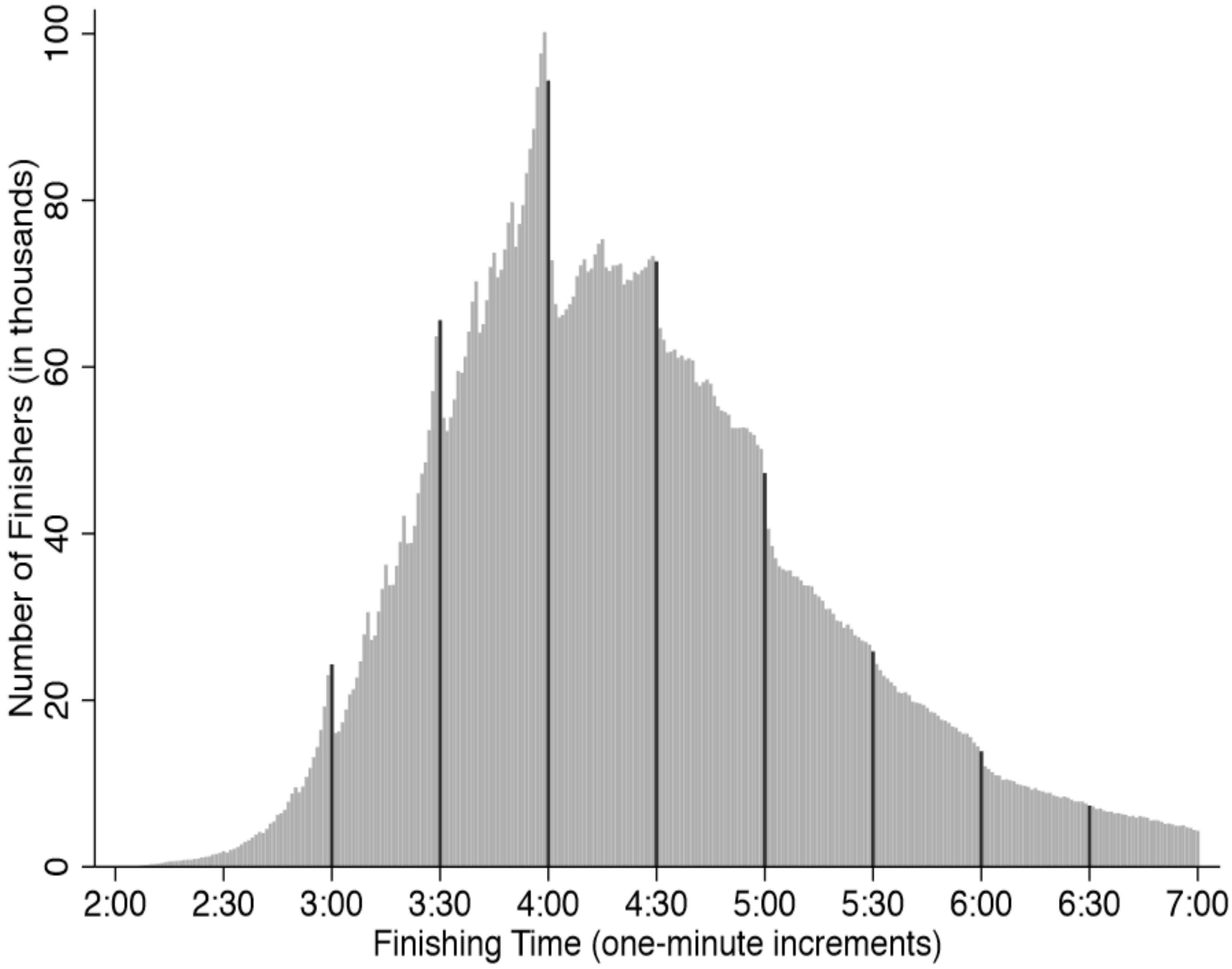
The marathon is a 26.2 mile road race that is popular with both professional athletes and recreational runners. The vast majority of runners receive no financial compensation for their performance.

For the overwhelming majority of runners, finishing times are a source of internal pride and fulfillment and not an extrinsic reward.

Question: Do runners bunch around round-numbered finishing times?

Allen, Dechow, Pope & Wu (2014): Reference-Dependent Preferences, Evidence from Marathon Runners

Figure 2: Distribution of marathon finishing times ($n = 9,524,071$)



Pope & Simonsohn (2011): Round Numbers as Goals

Evidence from college admissions data suggest that a student's probability of admission increases with their SAT score, but does not disproportionately change as their SAT scores pass round numbers (i.e., similar difference in admission rates for students getting 1490 vs. 1500 and 1500 vs. 1510).

Most juniors have the opportunity to retake the SATs in their senior year while most seniors don't have the time to take the test again.

Question: Are high school students more likely to retake the SATs if they get a score just below a round number (e.g., 1500)?

Pope & Simonsohn (2011): Round Numbers as Goals

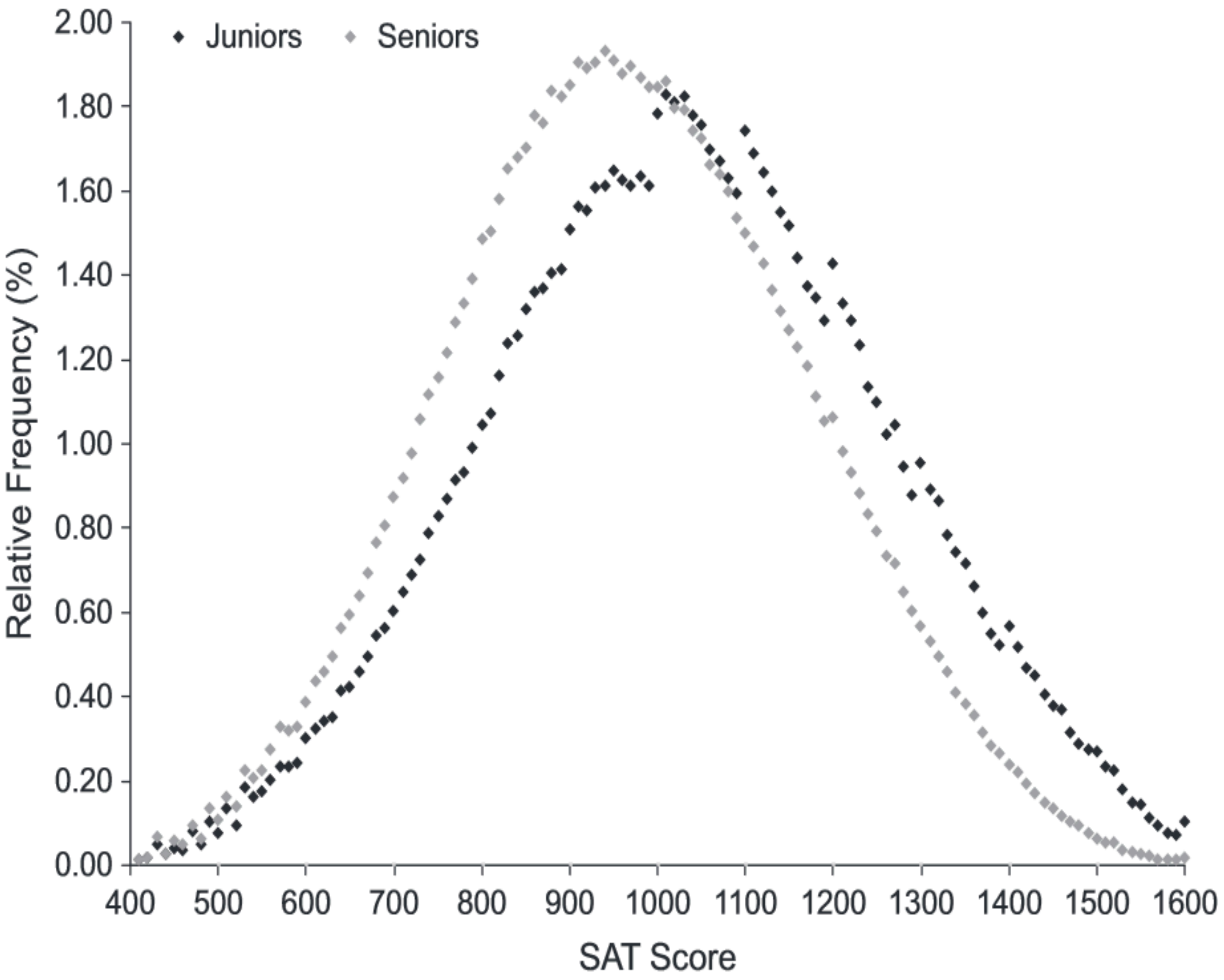


Fig. 3. Distribution of SAT scores of high school juniors and seniors. Only the final SAT score for each student was included in this data set.