Consumer Decision-making under Uncertainty on Digital Platforms

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Outline

Digital platforms

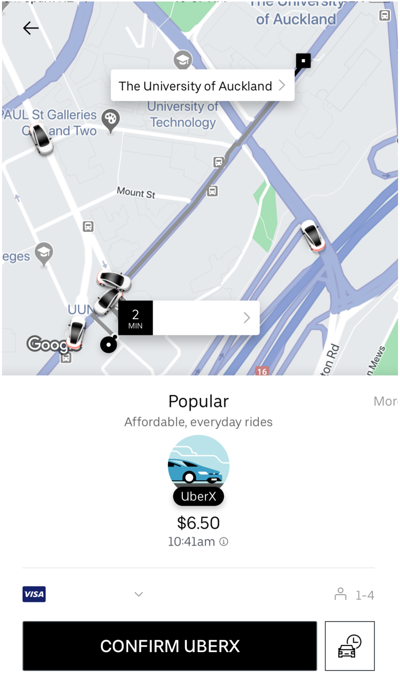
- Two or multi-sided markets.
- Our research focuses on user multi-homing and competition among ride-sharing platforms.
- Ride-sharing platforms facilitate transactions between riders and drivers.
- In 2018, the global uptake of ride-sharing services was around 11.8% (858 million riders), generating US$ 150 billion in revenue (Statista, 2019).
- The number of riders is projected to reach 1,500 million by 2023.

Platform pricing strategies

- Asymmetric pricing for different sides of the market (Rochet and Tirole, 2003).
- Merchant mode vs two-sided platform mode (Hagiu, 2007).
- Pricing mechanism to overcome competitive bottlenecks (Belleflamme and Peitz, 2019).
  - Users from one side of the market (but not the other) could multi-home.

Multi-homing

- Consumers can multi-home easily with free-to-install apps.
  - Low switching costs.
- In New Zealand, consumers can choose between a few ride-sharing platforms.
  - For simplicity, we will focus on Uber and Zoomy.
- Uber and Zoomy offer different pricing options to consumers.
  - Uber offers a fixed price.
  - Zoomy offers an estimated price range.



The University of Auckland
University of
Technology
PAUL St Galleries
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Popular
Affordable, everyday rides
UberX
$6.50
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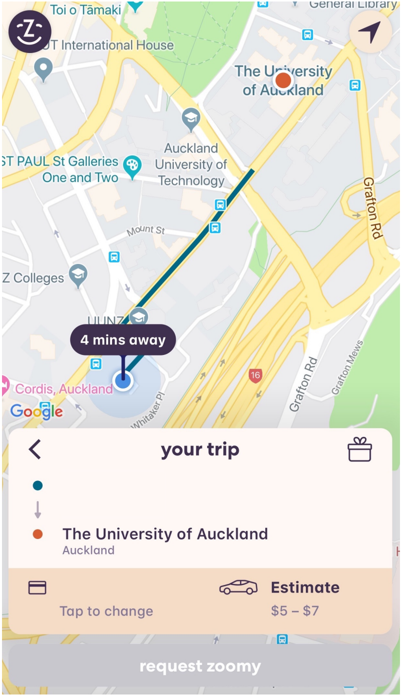
CONFIRM UBERX



Toi o Tāmaki
General Library
UT International House
The University
of Auckland
Auckland
University of
Technology
ST PAUL St Galleries
One and Two
Mount St
Grafton Rd
Z Colleges
4 mins away
Cordis, Auckland
your trip
The University of Auckland
Auckland
Tap to change
Estimate
$5 – $7
request zoomy

Ambiguity

- Zoomy's pricing scheme based on estimated price range introduces ambiguity to the consumer decision-making process.
- What is ambiguity?
  - Unmeasurable uncertainty.
  - The probability distribution of events related to an individual's decision-making process is unknown.
- The consumer does not know *a priori* the exact price of Zoomy's service.
  - Traffic.
  - Driver's route.
- A consumer's ambiguity attitude can influence whether they choose to accept the service from Uber or Zoomy.

Ambiguity attitudes

Savage axiom (sure-thing principle)

$$\Omega = \{..., s, ...\} \quad \varepsilon = \{..., E, ...\} \quad X = \{..., x, ...\}$$

$$F = \{..., f(\cdot), ...\} \quad f : \Omega \to X \quad f(\Omega) = \{x\}$$

For all events E and acts $f(\cdot)$, $g(\cdot)$, $h(\cdot)$ and $h'(\cdot)$, $f_E h \succeq g_E h \Rightarrow f_E h' \succeq g_E h'$.

$f_E h$ denotes the act with outcome $f(s)$ when $s \in E$; $h(s)$ when $s \in \Omega \setminus E$.

Ambiguity attitudes

- Uncertainty should not change your choice between two acts if that uncertainty does not affect your preference over the two acts.
- Ellsberg Paradox (1961).
  - Violation of sure thing principle.
  - A person prefers to bet in situations for which they know specific odds, rather than in situations for which the odds are ambiguous.

Utility representations under ambiguity

- MaxMin expected utility (EU) model (Gilboa & Schmeidler, 1989).
  - Ambiguity averse.
- MaxMax EU model (Gilboa & Schmeidler, 1989).
  - Ambiguity loving.
- α-MaxMin EU model (Hurwicz, 1951).
  - Parameter for the relative degree of optimism and pessimism, $\alpha \in [0, 1]$.
- Subjective EU model (Savage, 1954).
  - Ambiguity neutral.
- Prospect theory (Kahneman & Tversky, 1979).
  - Reference points can distort how individuals respond to ambiguity.
  - Loss aversion.

Research questions

- How do individuals form decisions when they face different pricing schemes from competing ride-sharing platforms?
- Could platforms offer distinct pricing schemes to serve consumers with different ambiguity attitudes to gain market share?

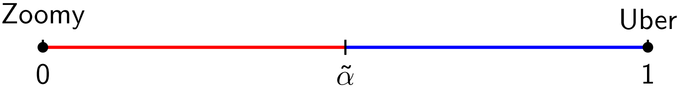
Model set-up

- Suppose two ambiguity neutral platforms - Uber and Zoomy - operate in the same market.
- Uber offers a price p_u and Zoomy offers the price range $[\,\underline{p}\,,\,\overline{p}\,]$ for the same ride.
- Each consumer perceives the price of a Zoomy ride as $\widetilde{p}_z \in [\,\underline{p}\,,\,\overline{p}\,]$.
- Normalise the mass of consumers in the market to 1.
- Parameter for the relative degree of optimism and pessimism of a consumer, $\alpha \in [0, 1]$.

$$\widetilde{p}_z = [\ \alpha\bar{p} + (1-\alpha)\underline{p}\ ]$$

Model

- A consumer's valuation of a ride from Zoomy or Uber is the same, V.
- Denote $\widetilde{\alpha}$ as the ambiguity attitude of the indifferent consumer.



$$V - \widetilde{p}_z = V - p_u$$

$$V - [\, \widetilde{\alpha}\bar{p} + (1 - \widetilde{\alpha})\underline{p} \,] = V - p_u$$

$$\Rightarrow \widetilde{\alpha} = \frac{p_u - \underline{p}}{\bar{p} - \underline{p}} = \frac{p_u - \underline{p}}{\triangle p}$$

Model

- Denote $f(\alpha)$ as the pdf for the distribution of the consumers' type (ambiguity attitudes).

Conditional expected perceived price for consumers served by Zoomy

$$E[\widetilde{p}_z|\alpha \leq \widetilde{\alpha}] = \frac{1}{\int_0^{\tilde{\alpha}} f(\alpha)\, d\alpha} \int_0^{\tilde{\alpha}} [\ \alpha\bar{p} + (1-\alpha)\underline{p}\ ]\, f(\alpha)\, d\alpha$$

Model

Assumption

The consumers' attitudes toward ambiguity follow a Beta distribution respectively with probability and cumulative density distributions satisfying

$$f(\alpha; a = 4, b = 2) = 20\,\alpha^{a-1}\,(1-\alpha)^{b-1} = 20\,\alpha^{3}\,(1-\alpha)$$

and

$$F(\alpha; a = 4, b = 2) = 20\left(\frac{\alpha^4}{4} - \frac{\alpha^5}{5}\right)$$

Model

Graphically:

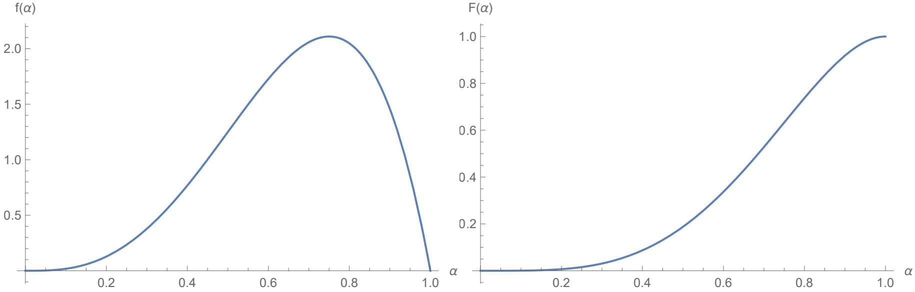


Figure: Beta distributions for the density, $f(\alpha; a = 4, b = 2)$, and cumulative, $F(\alpha; a = 4, b = 2)$, functions of consumers' attitudes toward ambiguity, α, with $0 \leq \alpha \leq 1$.

Model

Consequently, by using this Beta distribution the conditional expected price Zoomy can charge consumers can be rewritten as follows

$$E[\widetilde{p}_z|\alpha \leq \widetilde{\alpha}] = \frac{1}{\int_0^{\tilde{\alpha}} 20\,\alpha^3\,(1-\alpha)d\alpha} \int_0^{\tilde{\alpha}} [\ \alpha\bar{p} + (1-\alpha)\underline{p}\ ]\ 20\,\alpha^3\,(1-\alpha)\,d\alpha$$

Supply Side

- Normalise costs to zero for both Zoomy and Uber.
- The cdf for the mass of consumers served by Zoomy is $F(\widetilde{\alpha})$.
- Conversely, the cdf for the mass of consumers served by Uber is $1 - F(\widetilde{\alpha})$.

Zoomy's Profit-Maximization Problem

Zoomy's profit is equal to

$$\pi_z \; = \; E[\tilde{p}_z | \alpha \leq \tilde{\alpha}] \, F(\tilde{\alpha})$$

By Assumption 1

$$\pi_z \; = \; \int_0^{\tilde{\alpha}} [\; \alpha \bar{p} \; + \; (1 - \alpha) \underline{p} \;] \; 20 \, \alpha^3 \, (1 - \alpha) \, d\alpha$$

Equal to

$$\pi_z = 20 \left(\frac{\tilde{\alpha}^5}{5} \bar{p} - \frac{\tilde{\alpha}^6}{6} \bar{p} + \frac{\tilde{\alpha}^4}{4} \underline{p} - \frac{2\tilde{\alpha}^5}{5} \underline{p} + \frac{\tilde{\alpha}^6}{6} \underline{p} \right)$$

where

$$\tilde{\alpha} = \frac{p_u - \underline{p}}{\bar{p} - \underline{p}}$$

Uber's Profit-Maximization Problem

Uber's profit is equal to

$$\pi_u = p_u \left[1 - F(\widetilde{\alpha}) \right] \tag{1}$$

By Assumption 1, we can rewrite Uber's profit as

$$\pi_u = p_u \left(1 - \int_0^{\widetilde{\alpha}} 20\,\alpha^3 \,(1-\alpha) d\alpha \right)$$

Solving for the integral, this simplifies to

$$\pi_u = p_u \left(1 - 5\widetilde{\alpha}^4 + 4\widetilde{\alpha}^5 \right)$$

where

$$\widetilde{\alpha} = \frac{p_u - \underline{p}}{\bar{p} - \underline{p}}$$

Equilibrium Condition

The following relationship needs to hold for the system to provide a solution consistent with $\underline{p}^* < p_u^* < \bar{p}^*$

$$1 - \left(\frac{p_u^* - \underline{p}^*}{\bar{p}^* - \underline{p}^*}\right)^4 + 20p_u^*\left(\frac{1}{\bar{p}^* - \underline{p}^*}\right)\left(\left(\frac{p_u^* - \underline{p}^*}{\bar{p}^* - \underline{p}^*}\right) - 1\right)\left(\frac{p_u^* - \underline{p}^*}{\bar{p}^* - \underline{p}^*}\right)^3 = 0$$

However, there are infinitely many combinations of $\underline{p}^*$, $\bar{p}^*$ and p_u^* satisfying this consistency requirement and such that Uber and Zoomy would coexist in equilibrium.

Table 1

p_u^*	$\underline{p}^*$	$\bar{p}^*$	$\widetilde{\alpha}^*$
0.95	0.5	1.5	0.45
1.38	1	2	0.38
1.84	1.5	2.5	0.34
2.31	2	3	0.31
2.79	2.5	3.5	0.29

Table: Equilibrium cut-off for ambiguity loving types and associated optimal pricing in the ride-sharing market for $\bar{p}^* - \underline{p}^* = 1$

Table 2

p_u^*	$\underline{p}^*$	$\bar{p}^*$	$\widetilde{\alpha}^*$
1.5	0.5	2.5	0.50
1.90	1	3	0.45
2.33	1.5	3.5	0.415
2.77	2	4	0.385
3.23	2.5	4.5	0.365

Table: Optimal pricing in the ride-sharing market for $\bar{p}^* - \underline{p}^* = 2$

Table 3

p_u^*	$\underline{p}^*$	$\bar{p}^*$	$\widetilde{\alpha}^*$
3	1	5	0.50
4.5	1.5	7.5	0.50
6	2	10	0.50
7.5	2.5	12.5	0.50
9	3	15	0.50

Table: Optimal pricing in the ride-sharing market for $\underline{p}^* = \frac{1}{5}\bar{p}^*$

Analysis

Proposition

Under Assumption 1 competing ride-sharing services exploiting heterogeneous ambiguity attitudes of consumers, could set their respective prices such that $\underline{p}^* < p_u^* < \bar{p}^*$ and $\widetilde{\alpha}^* = \frac{1}{2}$, which always holds for $\frac{1}{5}\bar{p}^* = \underline{p}^* < p_u^* = \frac{1}{2}\underline{p}^* + \frac{1}{2}\bar{p}^* < \bar{p}^* = 5\underline{p}^*$.

Next, we can use this result to derive the induced optimal conditional expected price offered by Zoomy, which corresponds to

$$E\left[\widetilde{p}_z^* | \alpha \leq \widetilde{\alpha} = \frac{1}{2}\right] = p_u^* \frac{23}{27}$$

Analysis (Cont'd)

Corollary 1

Under Assumption 1, for $\widetilde{\alpha}^* = \frac{1}{2}$ the optimal prices in the ride-sharing market lead to $\widetilde{p}_z^* \in \left[\frac{1}{3}p_u^*, \frac{5}{3}p_u^*\right]$, with $E\left[\widetilde{p}_z^* | \alpha \leq \widetilde{\alpha}^* = \frac{1}{2}\right] = p_u^* \frac{23}{27}$.

Corollary 2

Under Assumption 1, for $\widetilde{\alpha}^* = \frac{1}{2}$ the corresponding market shares of competing ride-sharing services are respectively equal to $F(\widetilde{\alpha}) = 0.1875$ and $(1 - F(\widetilde{\alpha})) = 0.8125$.

Consumer surplus

Consumer surplus for consumers served by Zoomy

$$CS_z = (V - E[\widetilde{p}_z^* | \alpha \leq \widetilde{\alpha}^*]) \, F(\widetilde{\alpha}^*)$$

Consumer surplus for consumers served by Uber

$$CS_u = (V - p_u^*)(1 - F(\widetilde{\alpha}^*))$$

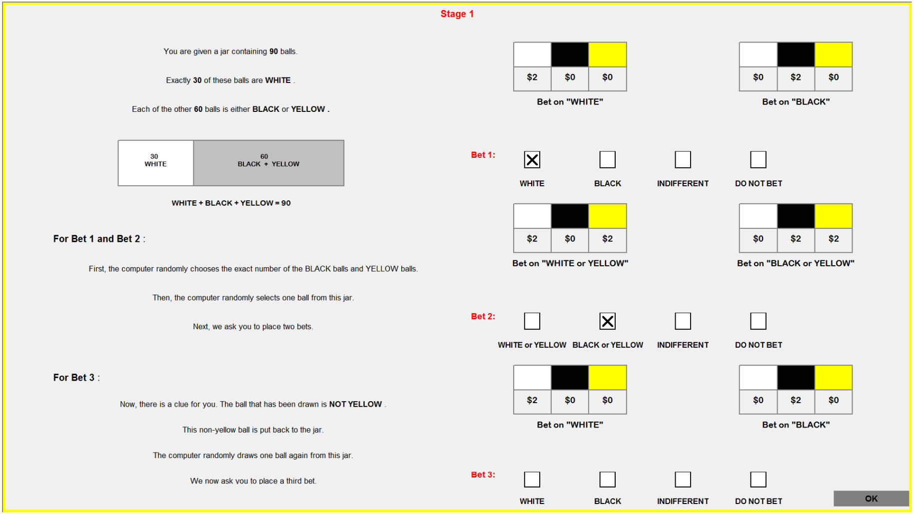
Experiment

- We received ethics approval from the University of Auckland Human Participants Ethics Committee (UAHPEC).
- We conducted a preliminary set of experimental sessions at the University of Auckland Laboratory for Business Decision Making (DECIDE) from the 12th to 27th of August 2019.
- We recruited the subjects via ORSEE: Online Recruitment Software for Economic Experiments (Greiner, 2004).
- Overall, a total of 113 subjects took part across six experimental sessions used to calibrate the distribution of consumers' attitudes toward ambiguity.
- In Jan/Feb 2020, we then repeated the same protocol to elicit subjects' attitudes toward ambiguity, before emulating choices in the ride-sharing market via a suitable protocol (Stages 2 and 3) via a computerized experiment implemented via z-Tree: Zurich Toolbox for Ready-made Economic Experiments (Fischbacher, 2007).

Stage 1

- We implement the modified Ellsberg three-colour urn game à la Cohen, Gilboa, Jaffray, and Schmeidler (2000) to elicit each participant's ambiguity attitude.
- Subjects are asked to place three consecutive bets on the colours of a randomly selected ball from a standard three-colour Ellsberg urn.
- Subjects receive NZD 2.00 for each correct bet.
- Subjects do not receive any feedback about the outcome of their bets until the end of the experiment.

Stage 1



$STP: \textit{For all events } E \textit{ and acts } f, g, h \textit{ and } h', \; f_E h \succeq g_E h \Rightarrow f_E h' \succeq g_E h'$

Stage 1

		Bet 1			
		White	Black	Indifferent	Do not bet
Bet 2	White or yellow	SEU	$\alpha < 1/2$	Inconsistent	Inconsistent
	Black or yellow	$\alpha > 1/2$	SEU	Inconsistent	Inconsistent
	Indifferent	Inconsistent	Inconsistent	SEU or $\alpha = 1/2$	Inconsistent
	Do not bet	Inconsistent	Inconsistent	Inconsistent	Inconsistent

Table: Ambiguity attitudes

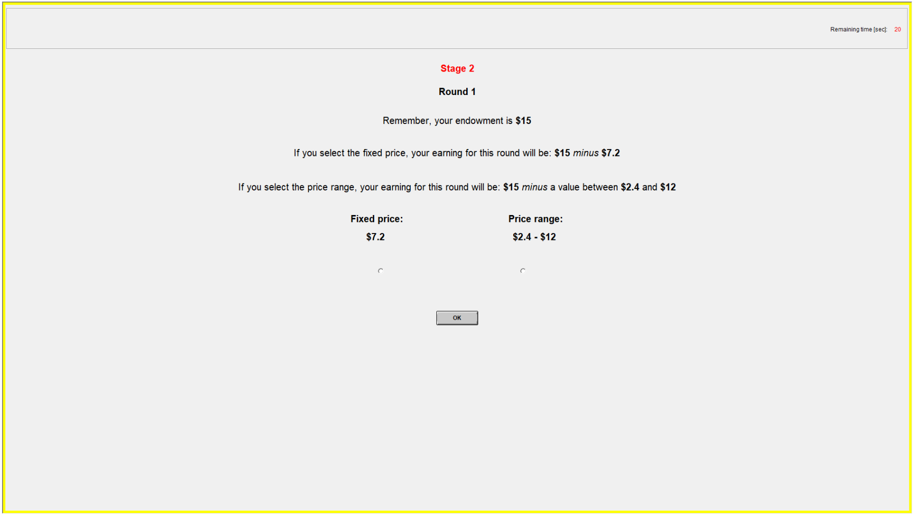
Stage 2

- We simulate individual decisions over binary pricing options – a fixed price and a price range – for 21 subsequent rounds.
- This design emulates the decision-making process of a multi-homing user in the ride-sharing market.
- In each round subjects are given an endowment of NZD 15.00.
- To address order effects, we shuffle the sequence in which the scenarios are presented to the subjects for each experimental session.
- At the end of the experiment, only one of the twenty-one rounds, which is randomly and independently selected by the computer, counts towards a subject's final payoff.

Stage 2 - Price calibrations

Scenarios	p_u^*	$\underline{p}^*$	$\bar{p}^*$	$E\left[\tilde{p}_z^* \vert \alpha \leq \tilde{\alpha} = \frac{1}{2}\right] = p_u^* \frac{23}{27}$
1	3	1	5	$3(\frac{23}{27})$
2	3.30	1.10	5.50	$3.3(\frac{23}{27})$
3	3.60	1.20	6	$3.60(\frac{23}{27})$
4	3.90	1.30	6.5	$3.90(\frac{23}{27})$
5	4.20	1.40	7	$4.20(\frac{23}{27})$
6	4.50	1.50	7.5	$4.50(\frac{23}{27})$
7	4.80	1.60	8	$4.80(\frac{23}{27})$
8	5.10	1.70	8.5	$5.10(\frac{23}{27})$
9	5.40	1.80	9	$5.40(\frac{23}{27})$
10	5.70	1.90	9.5	$5.70(\frac{23}{27})$
11	6	2	10	$6(\frac{23}{27})$
12	6.30	2.10	10.5	$6.30(\frac{23}{27})$
13	6.60	2.20	11	$6.60(\frac{23}{27})$
14	6.90	2.30	11.5	$6.90(\frac{23}{27})$
15	7.20	2.40	12	$7.20(\frac{23}{27})$
16	7.50	2.50	12.5	$7.50(\frac{23}{27})$
17	7.80	2.60	13	$7.80(\frac{23}{27})$
18	8.10	2.70	13.5	$8.10(\frac{23}{27})$
19	8.40	2.80	14	$8.40(\frac{23}{27})$
20	8.70	2.90	14.5	$8.70(\frac{23}{27})$
21	9	3	15	$9(\frac{23}{27})$

Stage 2


Remaining time [sec]: 20

Stage 2

Round 1

Remember, your endowment is **$15**

If you select the fixed price, your earning for this round will be: **$15** *minus* **$7.2**

If you select the price range, your earning for this round will be: **$15** *minus* a value between **$2.4** and **$12**

Fixed price:	**Price range:**
$7.2	**$2.4 - $12**

OK

Stage 3

- We propose five scenarios to subjects to assess the effect of framing on the individual's decision-making under pricing-related ambiguity.
- Subjects are informed that one of these scenarios is selected at random to determine their payoffs in this stage.
- In each round subjects are given an endowment of NZD 15.00.
- Subjects are asked to choose between two pricing options: a fixed price and (written description of) a price range.
  - The price range is expressed as the maximum value of a potential discount and the corresponding price cap, "up to 2/3 cheaper and at most 2/3 more expensive than the fixed price".

Stage 3

Remaining time [sec]: 25

Stage 3

Round 2

Once again, consider your endowment to be of **$15**

If you were asked to choose between the following two options, which one would you prefer?

Fixed price:	**Price range:**
$4.5	**Up to 2/3 cheaper and at most 2/3 more expensive than the fixed price**

OK

Stage 4

Results from Stage 1:

Bet 1 and Bet 2:
The color of the randomly selected ball was: **BLACK**

In Bet 1, your choice was: **WHITE**
Thus, your first bet was: **Wrong**

In Bet 2, your choice was: **BLACK or YELLOW**
Thus, your second bet was: **Correct**

Bet 3:
The color of the randomly selected ball was: **YELLOW**

In Bet 3, your choice was: **WHITE**
Thus, your third bet was: **Wrong**

Therefore, in Stage 1, your total earnings in NZD are:
$0.0 from Bet 1 + **$2.0** from Bet 2 + **$0.0** from Bet 3 = **$2.0**

In today's experiment, your final earnings in NZD are:
$2.0 from Stage 1 + **$8.1** from Stage 2 + **$6.0** from Stage 3 + **$10.0** show-up fee = **$26.1**

Results from Stage 2:

Round 6 has been randomly selected by the computer to calculate your payoff.

In **Round 6** the fixed price was **$6.9** and the price range was **$2.3 - $11.5**.

You selected the **Fixed Price** option in **Round 6**.

Therefore, your total earnings for Stage 2 is **$8.1**.

Results from Stage 3:

Round 4 has been randomly selected by the computer to calculate your payoff.

In **Round 4** the fixed price was **$9** and the price range was

up to 2/3 cheaper and at most 2/3 more expensive than the fixed price .

You selected the **Fixed Price** option in **Round 4**.

Therefore, your total earnings for Stage 3 is **$6.0**.

Stage 1

Ambiguity types	Participants	Percentage(%)
Ambiguity averse	11	32.3
SEU	19	55.9
Ambiguity loving	4	11.8

Table: Descriptive Statistics Stage 1

Stages 1 & 2

Variables	(1) N	(2) mean	(3) sd
All			
Choices	714	0.529	0.499
Ambiguity averse			
Choices	231	0.433	0.497
SEU			
Choices	399	0.617	0.487
Ambiguity loving			
Choices	84	0.381	0.489

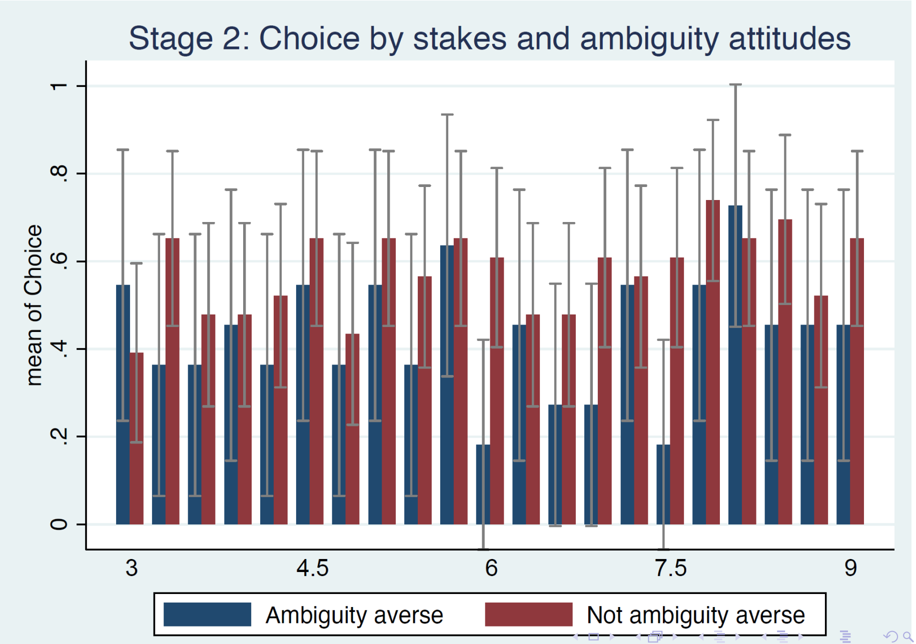
Table: Descriptive Statistics Stages 1 & 2

Stage 3

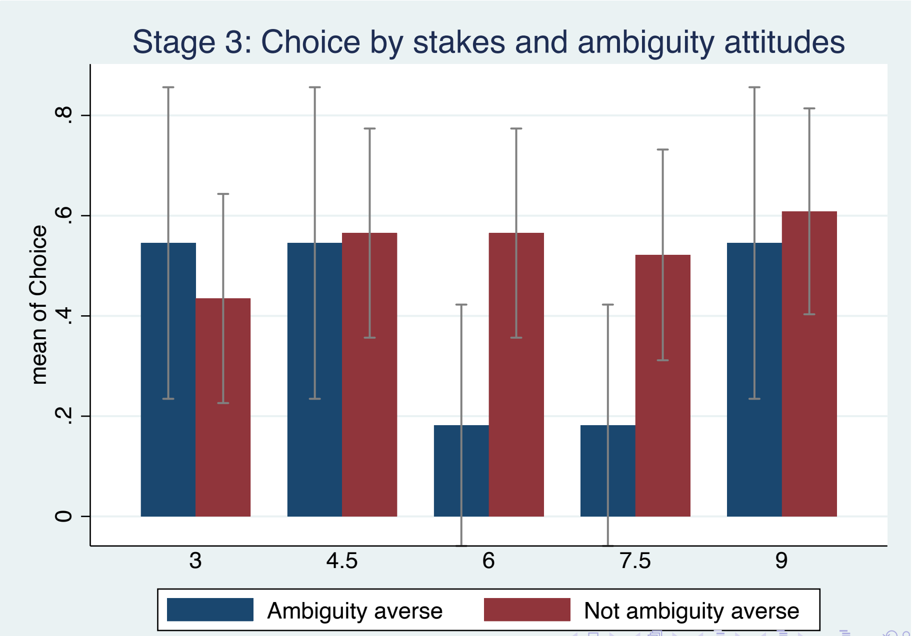
Variables	(1) N	(2) mean	(3) sd
All			
Choices	340	0.476	0.500
Ambiguity averse			
Choices	110	0.382	0.488
SEU			
Choices	190	0.563	0.497
Ambiguity loving			
Choices	40	0.325	0.474

Table: Descriptive Statistics Stage 3

Preliminary results: Stage 2



Preliminary results: Stage 3



Some Econometric Analysis: Stage 2

Variable	(1) All	(2) Ambiguity averse	(3) Not ambiguity averse
Stakes	0.0187*	0.00590	0.0248**
	(0.0103)	(0.0180)	(0.0124)
Constant	0.416***	0.397***	0.424***
	(0.0644)	(0.113)	(0.0775)
Observations	714	231	483
R-squared	0.005	0.000	0.008

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table: Stage 2 OLS Regressions

Some Econometric Analysis: Stage 3

Variables	(1) All	(2) Ambiguity averse	(3) Not ambiguity averse
Stakes	0.0294**	0.0182	0.0348**
	(0.0127)	(0.0220)	(0.0154)
Constant	0.300***	0.273*	0.313***
	(0.0809)	(0.140)	(0.0982)
Observations	340	110	230
R-squared	0.016	0.006	0.022

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table: Stage 3 OLS Regressions

Some Econometric Analysis: Stage 2 vs Stage 3

Variables	(1) All	(2) Ambiguity averse	(3) Not ambiguity averse
Stakes	0.0118	-0.0364	0.0348
	(0.0179)	(0.0305)	(0.0218)
Verbal Framing	-0.282*	-0.655**	-0.104
	(0.161)	(0.274)	(0.196)
Verbal Framing * Stakes	0.0353	0.109**	0
	(0.0253)	(0.0431)	(0.0308)
Constant	0.441***	0.600***	0.365***
	(0.114)	(0.194)	(0.139)
Observations	340	110	230
R-squared	0.026	0.063	0.033

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table: OLS regressions Stage 2 vs Stage 3

Price Range Choice Stage 2

```
Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Ambiguit |     231    .4329004    .0326708    .4965531    .3685281    .4972727
Not ambi |     483    .5755694    .0225128    .4947687    .5313341    .6198046
---------+--------------------------------------------------------------------
combined |     714    .5294118    .0186927    .4994841    .4927124    .5661111
---------+--------------------------------------------------------------------
    diff |           -.1426689    .0396258               -.2204663   -.0648715
------------------------------------------------------------------------------
    diff = mean(Ambiguit) - mean(Not ambi)                        t =  -3.6004
Ho: diff = 0                                     degrees of freedom =      712

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0002         Pr(|T| > |t|) = 0.0003          Pr(T > t) = 0.9998
```

Price Range Choice Stage 2, $p_u^* = 3.3$

```
. drop if Stakes!=3.3
(680 observations deleted)

. encode(AmbiguityAverse), generate(av)

. ttest Choice, by(av) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Ambiguit |      11    .3636364      .15212     .504525    .0246919    .7025809
Not ambi |      23    .6521739    .1015433    .4869848    .4415859    .8627619
---------+--------------------------------------------------------------------
combined |      34    .5588235    .0864344    .5039947    .3829715    .7346756
---------+--------------------------------------------------------------------
    diff |           -.2885375    .1828976               -.6711206    .0940455
------------------------------------------------------------------------------
    diff = mean(Ambiguit) - mean(Not ambi)                        t =  -1.5776
Ho: diff = 0                     Satterthwaite's degrees of freedom =  19.1673

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0655         Pr(|T| > |t|) = 0.1310          Pr(T > t) = 0.9345
```

Price Range Choice Stage 2, $p_u^* = 6$

```
. drop if Stakes!=6
(680 observations deleted)

. encode(AmbiguityAverse), generate(av)

. ttest Choice, by(av) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Ambiguit |      11    .1818182    .1219673    .4045199    -.089942    .4535784
Not ambi |      23    .6086957     .104051    .4990109    .3929072    .8244841
---------+--------------------------------------------------------------------
combined |      34    .4705882    .0868881    .5066404     .293813    .6473634
---------+--------------------------------------------------------------------
    diff |           -.4268775    .1603204                -.757719   -.0960359
------------------------------------------------------------------------------
    diff = mean(Ambiguit) - mean(Not ambi)                        t =  -2.6627
Ho: diff = 0                     Satterthwaite's degrees of freedom =  24.0598

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0068         Pr(|T| > |t|) = 0.0136          Pr(T > t) = 0.9932
```

Price Range Choice Stage 2, $p_u^* = 6.9$

```
. drop if Stakes!=6.9
(680 observations deleted)

. encode(AmbiguityAverse), generate(av)

. ttest Choice, by(av) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Ambiguit	11	.2727273	.1408358	.4670994	-.0410744	.5865289
Not ambi	23	.6086957	.104051	.4990109	.3929072	.8244841
combined	34	.5	.0870388	.5075192	.3229182	.6770818
diff		-.3359684	.1751037		-.700068	.0281313

```
    diff = mean(Ambiguit) - mean(Not ambi)                        t =  -1.9187
Ho: diff = 0                         Satterthwaite's degrees of freedom =   21.046

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0343         Pr(|T| > |t|) = 0.0687          Pr(T > t) = 0.9657
```

Price Range Choice Stage 2, $p_u^* = 7.5$

```
. drop if Stakes!=7.5
(680 observations deleted)

. encode(AmbiguityAverse), generate(av)

. ttest Choice, by(av) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Ambiguit |      11    .1818182    .1219673    .4045199    -.089942    .4535784
Not ambi |      23    .6086957     .104051    .4990109    .3929072    .8244841
---------+--------------------------------------------------------------------
combined |      34    .4705882    .0868881    .5066404     .293813    .6473634
---------+--------------------------------------------------------------------
    diff |           -.4268775    .1603204                -.757719   -.0960359
------------------------------------------------------------------------------
    diff = mean(Ambiguit) - mean(Not ambi)                        t =  -2.6627
Ho: diff = 0                     Satterthwaite's degrees of freedom =  24.0598

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0068         Pr(|T| > |t|) = 0.0136          Pr(T > t) = 0.9932
```

Choice Across Stages for Amb. Averse Types, $p_u^* = 3$

```
. drop if Stakes!=3
(272 observations deleted)

. drop if Averse ==0
(46 observations deleted)

. encode(verbal), generate(verb)

. ttest Choice, by(verbal) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Not verb |      11    .5454545    .1574592     .522233    .1946137    .8962954
  Verbal |      11    .1818182    .1219673    .4045199    -.089942    .4535784
---------+--------------------------------------------------------------------
combined |      22    .3636364    .1049728     .492366    .1453335    .5819392
---------+--------------------------------------------------------------------
    diff |            .3636364    .1991718               -.0534998    .7807725
------------------------------------------------------------------------------
    diff = mean(Not verb) - mean(Verbal)                          t =   1.8257
Ho: diff = 0                     Satterthwaite's degrees of freedom =  18.8235

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9581         Pr(|T| > |t|) = 0.0838          Pr(T > t) = 0.0419
```

Choice Across Stages for Amb. Averse Types, $p_u^* = 9$

```
. drop if Stakes!=9
(272 observations deleted)

. drop if Averse ==0
(46 observations deleted)

. encode(verbal), generate(verb)

. ttest Choice, by(verbal) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Not verb	11	.4545455	.1574592	.522233	.1037046	.8053863
Verbal	11	.7272727	.1408358	.4670994	.4134711	1.041074
combined	22	.5909091	.1072903	.5032363	.3677866	.8140316
diff		-.2727273	.2112536		-.7137437	.1682891

```
    diff = mean(Not verb) - mean(Verbal)                      t =  -1.2910
Ho: diff = 0                     Satterthwaite's degrees of freedom =  19.7561

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1058         Pr(|T| > |t|) = 0.2116          Pr(T > t) = 0.8942
```

Choice Across Stages for Non-Amb. Averse Types, $p_u^* = 4.5$

```
. drop if Stakes!=4.5
(272 observations deleted)

. drop if Averse ==1
(22 observations deleted)

. encode(verbal), generate(verb)

. ttest Choice, by(verbal) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Not verb	23	.6086957	.104051	.4990109	.3929072	.8244841
Verbal	23	.3913043	.104051	.4990109	.1755159	.6070928
combined	46	.5	.0745356	.505525	.3498776	.6501224
diff		.2173913	.1471503		-.0791706	.5139532

```
    diff = mean(Not verb) - mean(Verbal)                          t =   1.4773
Ho: diff = 0                     Satterthwaite's degrees of freedom =       44

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9266         Pr(|T| > |t|) = 0.1467          Pr(T > t) = 0.0734
```

Conclusion and Further Research

- First of all, similar to other attempts to model and then test complex human behaviour, we needed to make simplifying assumptions.
  - $\rightarrow$ The price calibrations in the experiment are based on the theoretical assumptions that the consumers' ambiguity types in the market follow a Beta distribution, skewed towards ambiguity-averse types.
  - $\rightarrow$ This is a convenient, yet realistic, assumption to impose on our model.
- Secondly, the statistical power of our data will depend on the number of observations we will be able to gather from the subject population.
  - $\rightarrow$ Only few subjects were identified as ambiguity loving individuals, restricting our ability to infer robust results from available data.
  - $\rightarrow$ We were planning more experimental sessions in April/May this year, but COVID–19 meant postponing those to the second half of 2020.
- As an extension of this study, we could direct our attention to the other side of the ride-sharing platform, by modelling the behaviour of multihoming drivers.
- Equally, we could look at more general models of competing mixed price offers (fixed & range) in a variety of mkts (e.g. hotel bookings, labor contracts).