Homework #4

Hayden Atchley

October 08, 2021

In order to estimate the models, we first need to load the data:

```
worktrips <- read_rds("data/worktrips_dfidx.rds")
```

4.1

The three models I calculated are the equal-shares, market shares, and travel time. the equal-shares model has a probability of 1/6 for each mode, since there are 6 modes. The other two models are presented below:

```
lmint <- mlogit(CHOSEN ~ 1, worktrips)
lmtt <- mlogit(CHOSEN ~ TVTT, worktrips)

list(Market = lmint, Travel = lmtt) %>%
  my_msummary() %>%
  align(j = 2:3, align = "center", part = "all")
```

	Market	Travel
(Intercept) × Share 2	-1.951 (0.047)***	-1.860 (0.051)***
(Intercept) × Share 3++	-3.118 (0.081)***	-2.941 (0.084)***
(Intercept) × Transit	-1.988 (0.048)***	-0.536 (0.083)***
(Intercept) × Bike	-4.287 (0.142)***	-2.537 (0.150)***
(Intercept) × Walk	-3.087 (0.079)***	-0.207 (0.124)+
TVTT		-0.054 (0.003)***
Num.Obs.	5029	5029
Log.Lik.	-4857.182	-3924.362
rho2	0.000	0.192
rho20	0.461	0.564

The rho2 and rho20 values given are the ρ^2 values with respect to the market shares and equal-shares models, respectively. The `summary()` command generally reports only the first of these two values, so in many cases the ρ^2 value is relative to the market shares (or average) model.

4.2

I estimated a model with just travel time and cost:

```
lmvot <- mlogit(CHOSEN ~ TVTT + COST, worktrips)
list(VOT_model = lmvot) %>%
  my_msummary() %>%
  align(j = 2, align = "center", part = "all")
```

	VOT_model
(Intercept) × Share 2	-2.308 (0.055)***
(Intercept) × Share 3++	-3.702 (0.093)***
(Intercept) × Transit	-0.974 (0.088)***
(Intercept) × Bike	-3.071 (0.154)***
(Intercept) × Walk	-0.704 (0.129)***
TVTT	-0.051 (0.003)***
COST	-0.005 (0.000)***
Num.Obs.	5029
Log.Lik.	-3637.579
rho2	0.251
rho20	0.596

The value of time (VOT) is the time coefficient divided by the cost coefficient, adjusting for units to get dollars per hour:

```
vot <- unname(lmvot$coefficients["TVTT"]) /
  unname(lmvot$coefficients["COST"]) *
  (60/100)
vot
```

```
## [1] 6.321381
```

This is possibly a bit low, considering average wages, but it may be that people value their time less when travelling than when working, as travel usually requires less effort. I think it may be too low, but not by too much.

4.3

I calculated a model with IVTT and OVTT:

```
lmwait <- mlogit(CHOSEN ~ IVTT + OVTT, worktrips)
list(wait_model = lmwait) %>%
  my_msummary() %>%
  align(j = 2, align = "center", part = "all")
```

	wait_model
(Intercept) × Share 2	-2.106 (0.055)***
(Intercept) × Share 3++	-3.271 (0.088)***
(Intercept) × Transit	-0.276 (0.100)**
(Intercept) × Bike	-3.293 (0.170)***
(Intercept) × Walk	-2.288 (0.091)***
IVTT	-0.001 (0.005)
OVTT	-0.085 (0.005)***
Num.Obs.	5029
Log.Lik.	-3956.831
rho2	0.185
rho20	0.561

In order to see how people regard waiting vs. traveling, I divided the OVTT by IVTT:

```
wait <- unname(lmwait$coefficients["OVTT"]) /
  unname(lmwait$coefficients["IVTT"])
wait
```

```
## [1] 84.65068
```

This implies that people hate waiting over 80 times more than they hate IVTT, which is quite a significant gap! This seems to me to be a bit high, but people do really hate waiting, so it may not be too unreasonable after all.

4.4

I estimated a model with residential population density and workplace employment density, as well as with affordability:

```
lmdens <- mlogit(CHOSEN ~ COSTINC | RSPOPDEN + WKEMPDEN, worktrips)
list(density_model = lmdens) %>%
  my_msummary() %>%
  align(j = 2, align = "center", part = "all")
```

	density_model
(Intercept) × Share 2	-2.326 (0.066)***
(Intercept) × Share 3++	-3.581 (0.133)***
(Intercept) × Transit	-2.792 (0.073)***
(Intercept) × Bike	-3.978 (0.204)***
(Intercept) × Walk	-2.531 (0.117)***
COSTINC	-0.062 (0.010)***
RSPOPDEN × Share 2	-0.002 (0.002)
RSPOPDEN × Share 3++	-0.011 (0.005)*
RSPOPDEN × Transit	0.000 (0.000)
RSPOPDEN × Bike	0.015 (0.005)**
RSPOPDEN × Walk	0.005 (0.002)*
WKEMPDEN × Share 2	0.002 (0.000)***
WKEMPDEN × Share 3++	0.004 (0.000)***
WKEMPDEN × Transit	0.006 (0.000)***
WKEMPDEN × Bike	0.002 (0.001)
WKEMPDEN × Walk	0.003 (0.001)***
Num.Obs.	5029
Log.Lik.	-3707.445
rho2	0.237
rho20	0.589

It appears that the coefficients for employment density are generally more statistically significant, though some of the coefficients for residential density are higher, especially for walking and biking.