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Model run by Vivit using Apollo 0.2.8 on R 4.2.2 for Windows.
www.ApolloChoiceModelling.com

Model name                            : MNL_SP
Model description                     : Simple MNL model on mode choice SP
data
Model run at                          : 2023-03-31 00:28:13
Estimation method                     : bfgs
Model diagnosis                       : successful convergence
Number of individuals                 : 112
Number of rows in database            : 448
Number of modelled outcomes           : 448

Number of cores used                  :  1
Model without mixing

LL(start)                             : -492.18
LL at equal shares, LL(0)             : -492.18
LL at observed shares, LL(C)          : -474.14
LL(final)                             : -463.03
Rho-squared vs equal shares           :  0.0592
Adj.Rho-squared vs equal shares       :  0.0409
Rho-squared vs observed shares        :  0.0234
Adj.Rho-squared vs observed shares    :  0.0044
AIC                                   :  944.06
BIC                                   :  981

Estimated parameters                  :  9
Time taken (hh:mm:ss)                 :  00:00:1.06
    pre-estimation                    :  00:00:0.55
    estimation                        :  00:00:0.18
    post-estimation                   :  00:00:0.33
Iterations                            :  18
Min abs eigenvalue of Hessian         :  4.22986

Unconstrained optimisation.

These outputs have had the scaling used in estimation applied to them.
Estimates:
                Estimate        s.e.    t.rat.(0)    Rob.s.e. Rob.t.rat.(0)
ASC_BUS        -2.113428    0.468150     -4.5144    0.447328      -4.7246
ASC_WALK        0.000000          NA          NA          NA           NA
ASC_MOTOBIKE    0.000000          NA          NA          NA           NA
b_tt_BUS       -0.009578    0.008664     -1.1054    0.007297      -1.3125
b_tt_WALK      -0.184539    0.053002     -3.4817    0.054146      -3.4082
b_tt_MOTOBIKE  -0.052710    0.026828     -1.9648    0.020631      -2.5549
b_cost         -0.074244    0.032413     -2.2906    0.034083      -2.1783
b_air           0.565552    0.252003      2.2442    0.315372       1.7933
b_shade         0.101738    0.203112      0.5009    0.222277       0.4577
b_helmet       -0.475054    0.205130     -2.3159    0.200389      -2.3707
```

b_pavement   0.292677   0.205622   1.4234   0.232805   1.2572

Overview of choices for MNL model component :
                                    WALK   BUS MOTOBIKE
Times available   448.00 448.00   448.00
Times chosen   182.00 92.00   174.00
Percentage chosen overall   40.62 20.54   38.84
Percentage chosen when available 40.62 20.54   38.84

Classical covariance matrix:
                     ASC_BUS   b_tt_BUS   b_tt_WALK b_tt_MOTOBIKE
ASC_BUS   0.219164   -0.001369   0.015099   0.002805
b_tt_BUS   -0.001369   7.507e-05   1.5984e-04   9.339e-05
b_tt_WALK   0.015099   1.5984e-04   0.002809   6.8494e-04
b_tt_MOTOBIKE   0.002805   9.339e-05   6.8494e-04   7.1973e-04
b_cost   0.008553   3.688e-05   0.001208   -9.711e-05
b_air   -0.031473   5.571e-05   0.001827   -3.892e-05
b_shade   0.008909   -6.151e-05   -0.002365   -4.2424e-04
b_helmet   0.041510   5.688e-05   0.004116   8.7318e-04
b_pavement   0.002308   -3.0694e-04   -0.003795   -0.001025
                      b_cost   b_air   b_shade   b_helmet
ASC_BUS   0.008553   -0.031473   0.008909   0.041510
b_tt_BUS   3.688e-05   5.571e-05   -6.151e-05   5.688e-05
b_tt_WALK   0.001208   0.001827   -0.002365   0.004116
b_tt_MOTOBIKE   -9.711e-05   -3.892e-05   -4.2424e-04   8.7318e-04
b_cost   0.001051   0.001053   3.6703e-04   8.3998e-04
b_air   0.001053   0.063505   -0.009737   -0.006683
b_shade   3.6703e-04   -0.009737   0.041254   0.002785
b_helmet   8.3998e-04   -0.006683   0.002785   0.042078
b_pavement   -4.298e-05   -0.007442   0.002408   -0.001558
                   b_pavement
ASC_BUS   0.002308
b_tt_BUS   -3.0694e-04
b_tt_WALK   -0.003795
b_tt_MOTOBIKE   -0.001025
b_cost   -4.298e-05
b_air   -0.007442
b_shade   0.002408
b_helmet   -0.001558
b_pavement   0.042280

Robust covariance matrix:
                     ASC_BUS   b_tt_BUS   b_tt_WALK b_tt_MOTOBIKE
ASC_BUS   0.200102   -0.001348   0.012861   0.001913
b_tt_BUS   -0.001348   5.325e-05   1.1195e-04   3.243e-05
b_tt_WALK   0.012861   1.1195e-04   0.002932   4.2802e-04
b_tt_MOTOBIKE   0.001913   3.243e-05   4.2802e-04   4.2566e-04
b_cost   0.007489   1.323e-05   0.001219   -1.6798e-04

b_air	-0.040151	-1.7345e-04	0.002290	-3.9369e-04
b_shade	0.019237	-2.6559e-04	-0.002084	-8.6256e-04
b_helmet	0.036166	-3.928e-05	0.003713	0.001286
b_pavement	0.002555	-5.8891e-04	-0.006369	-0.001381
	b_cost	b_air	b_shade	b_helmet
ASC_BUS	0.007489	-0.040151	0.019237	0.036166
b_tt_BUS	1.323e-05	-1.7345e-04	-2.6559e-04	-3.928e-05
b_tt_WALK	0.001219	0.002290	-0.002084	0.003713
b_tt_MOTOBIKE	-1.6798e-04	-3.9369e-04	-8.6256e-04	0.001286
b_cost	0.001162	0.002066	0.001889	1.7996e-04
b_air	0.002066	0.099459	-6.9978e-04	-0.003327
b_shade	0.001889	-6.9978e-04	0.049407	0.003473
b_helmet	1.7996e-04	-0.003327	0.003473	0.040156
b_pavement	-7.3400e-04	-0.006691	0.009431	-0.003229
	b_pavement			
ASC_BUS	0.002555			
b_tt_BUS	-5.8891e-04			
b_tt_WALK	-0.006369			
b_tt_MOTOBIKE	-0.001381			
b_cost	-7.3400e-04			
b_air	-0.006691			
b_shade	0.009431			
b_helmet	-0.003229			
b_pavement	0.054198			

Classical correlation matrix:

	ASC_BUS	b_tt_BUS	b_tt_WALK	b_tt_MOTOBIKE
ASC_BUS	1.00000	-0.33758	0.6085	0.223360
b_tt_BUS	-0.33758	1.00000	0.3481	0.401765
b_tt_WALK	0.60850	0.34806	1.0000	0.481695
b_tt_MOTOBIKE	0.22336	0.40177	0.4817	1.000000
b_cost	0.56363	0.13132	0.7031	-0.111675
b_air	-0.26678	0.02551	0.1368	-0.005757
b_shade	0.09369	-0.03495	-0.2197	-0.077856
b_helmet	0.43225	0.03200	0.3786	0.158667
b_pavement	0.02397	-0.17229	-0.3482	-0.185750
	b_cost	b_air	b_shade	b_helmet
ASC_BUS	0.563631	-0.266778	0.09369	0.43225
b_tt_BUS	0.131316	0.025513	-0.03495	0.03200
b_tt_WALK	0.703094	0.136771	-0.21971	0.37857
b_tt_MOTOBIKE	-0.111675	-0.005757	-0.07786	0.15867
b_cost	1.000000	0.128962	0.05575	0.12633
b_air	0.128962	1.000000	-0.19023	-0.12928
b_shade	0.055750	-0.190233	1.00000	0.06684
b_helmet	0.126335	-0.129275	0.06684	1.00000
b_pavement	-0.006448	-0.143628	0.05765	-0.03694
	b_pavement			
ASC_BUS	0.023973			
b_tt_BUS	-0.172287			
b_tt_WALK	-0.348180			

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b_tt_MOTOBIKE        -0.185750
b_cost               -0.006448
b_air                -0.143628
b_shade               0.057646
b_helmet             -0.036938
b_pavement            1.000000
```

Robust correlation matrix:

	ASC_BUS	b_tt_BUS	b_tt_WALK	b_tt_MOTOBIKE
ASC_BUS	1.00000	-0.41295	0.5310	0.20724
b_tt_BUS	-0.41295	1.00000	0.2833	0.21541
b_tt_WALK	0.53100	0.28334	1.0000	0.38315
b_tt_MOTOBIKE	0.20724	0.21541	0.3831	1.00000
b_cost	0.49118	0.05318	0.6606	-0.23889
b_air	-0.28461	-0.07537	0.1341	-0.06051
b_shade	0.19347	-0.16375	-0.1731	-0.18809
b_helmet	0.40346	-0.02686	0.3422	0.31101
b_pavement	0.02454	-0.34667	-0.5053	-0.28757

	b_cost	b_air	b_shade	b_helmet
ASC_BUS	0.49118	-0.284611	0.193467	0.40346
b_tt_BUS	0.05318	-0.075370	-0.163750	-0.02686
b_tt_WALK	0.66059	0.134124	-0.173140	0.34219
b_tt_MOTOBIKE	-0.23889	-0.060507	-0.188091	0.31101
b_cost	1.00000	0.192211	0.249322	0.02635
b_air	0.19221	1.000000	-0.009983	-0.05264
b_shade	0.24932	-0.009983	1.000000	0.07797
b_helmet	0.02635	-0.052639	0.077966	1.00000
b_pavement	-0.09251	-0.091136	0.182244	-0.06921

	b_pavement
ASC_BUS	0.02454
b_tt_BUS	-0.34667
b_tt_WALK	-0.50529
b_tt_MOTOBIKE	-0.28757
b_cost	-0.09251
b_air	-0.09114
b_shade	0.18224
b_helmet	-0.06921
b_pavement	1.00000

```
 20 worst outliers in terms of lowest average per choice prediction:
  ID Avg prob per choice
  56           0.1736176
  31           0.2309470
  36           0.2337011
  52           0.2337011
  34           0.2343499
 104           0.2494825
  50           0.2500797
  81           0.2541250
  80           0.2690221
```

```
112          0.2712469
 39          0.2732459
 62          0.2876774
 35          0.2913167
 55          0.2913167
 59          0.2925403
 99          0.2960509
  3          0.2970833
 19          0.2970833
 10          0.2991338
 75          0.3010212
```

Changes in parameter estimates from starting values:

	Initial	Estimate	Difference
ASC_BUS	0.000	-2.113428	-2.113428
ASC_WALK	0.000	0.000000	0.000000
ASC_MOTOBIKE	0.000	0.000000	0.000000
b_tt_BUS	0.000	-0.009578	-0.009578
b_tt_WALK	0.000	-0.184539	-0.184539
b_tt_MOTOBIKE	0.000	-0.052710	-0.052710
b_cost	0.000	-0.074244	-0.074244
b_air	0.000	0.565552	0.565552
b_shade	0.000	0.101738	0.101738
b_helmet	0.000	-0.475054	-0.475054
b_pavement	0.000	0.292677	0.292677

Settings and functions used in model definition:

apollo_control

	Value
modelName	"MNL_SP"
modelDescr	"Simple MNL model on mode choice SP data"
indivID	"ID"
outputDirectory	"output/"
debug	"FALSE"
nCores	"1"
workInLogs	"FALSE"
seed	"13"
mixing	"FALSE"
HB	"FALSE"
noValidation	"FALSE"
noDiagnostics	"FALSE"
calculateLLC	"TRUE"
panelData	"TRUE"
analyticGrad	"TRUE"
analyticGrad_manualSet	"FALSE"

Hessian routines attempted
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numerical jacobian of LL analytical gradient

Scaling in estimation

                        Value
ASC_BUS   2.11342648
b_tt_BUS   0.00957759
b_tt_WALK   0.18453897
b_tt_MOTOBIKE   0.05271028
b_cost   0.07424360
b_air   0.56555180
b_shade   0.10173775
b_helmet   0.47505387
b_pavement   0.29267659

Scaling used in computing Hessian

                        Value
ASC_BUS   2.113428131
b_tt_BUS   0.009577591
b_tt_WALK   0.184539143
b_tt_MOTOBIKE   0.052710270
b_cost   0.074243561
b_air   0.565551739
b_shade   0.101737744
b_helmet   0.475053709
b_pavement   0.292676539

apollo_probabilities
----
function(apollo_beta, apollo_inputs, functionality="estimate"){

  ### Attach inputs and detach after function exit
  apollo_attach(apollo_beta, apollo_inputs)
  on.exit(apollo_detach(apollo_beta, apollo_inputs))

  ### Create list of probabilities P
  P = list()

  ### List of utilities: these must use the same names as in mnl_settings, order is
irrelevant
  V = list()
  V[["BUS"]]   = ASC_BUS + (b_tt_BUS * time_bus) + (b_cost * cost_bus) + (b_air *
Attbus_air)
  V[["WALK"]] = ASC_WALK + (b_tt_WALK * time_walk) + (b_shade * Attwalk_shade) +
(b_pavement * Attwalk_pavement)
  V[["MOTOBIKE"]] = ASC_MOTOBIKE + (b_tt_MOTOBIKE * time_mc)   + (b_cost *
cost_mc) + (b_helmet * Attmc_helmet)

```
  ### Define settings for MNL model component
  mnl_settings = list(
    alternatives  = c(WALK=1, BUS=2, MOTOBIKE=3),
    avail         = list(BUS=av_bus, WALK=av_walk, MOTOBIKE=av_mc),
    choiceVar     = choice,
    utilities     = V
  )

  ### Compute probabilities using MNL model
  P[["model"]] = apollo_mnl(mnl_settings, functionality)

  ### Take product across observation for same individual
  P = apollo_panelProd(P, apollo_inputs, functionality)

  ### Prepare and return outputs of function
  P = apollo_prepareProb(P, apollo_inputs, functionality)
  return(P)
}
<bytecode: 0x00000261602fd218>
```