PATH Forecast :: Scenarios

Planning & Regional Development

10/08/2020

DRAFT

Summary

Outputs using the PATH econmetric forecasting model and October employment inputs (moderate and protracted). Ridership and Hudson County population inputs held constant as of February 2020.

One note of significance here is that our vendor, Oxford Economics, is projecting a decrease in *Hudson County population*, seen below. Our previous update (August) incorporated Oxford's expectation for reduced *employment* into the PATH forecast, but those expectations remain largely unchanged between August and October; this forecast incorporates the new expectations for *population*, which puts downward pressure on the weekend projections.

This model iteration only updates the moderate scenario. References here and in the data output files to the protracted scenario and associated data refer to the August run.

```
end = "2020-02-01"
end_and_one = "2020-03-01"
end_cpi = "2020-10-01"
```

```
path = read.csv("./input data/PATH_PaxCounts_2000-2009+2010-2020Apr.csv")
path$month = as.Date(paste(path$year, str_pad(path$month, 2,
    pad = "0"), "01", sep = "-"))
path$year = NULL
```
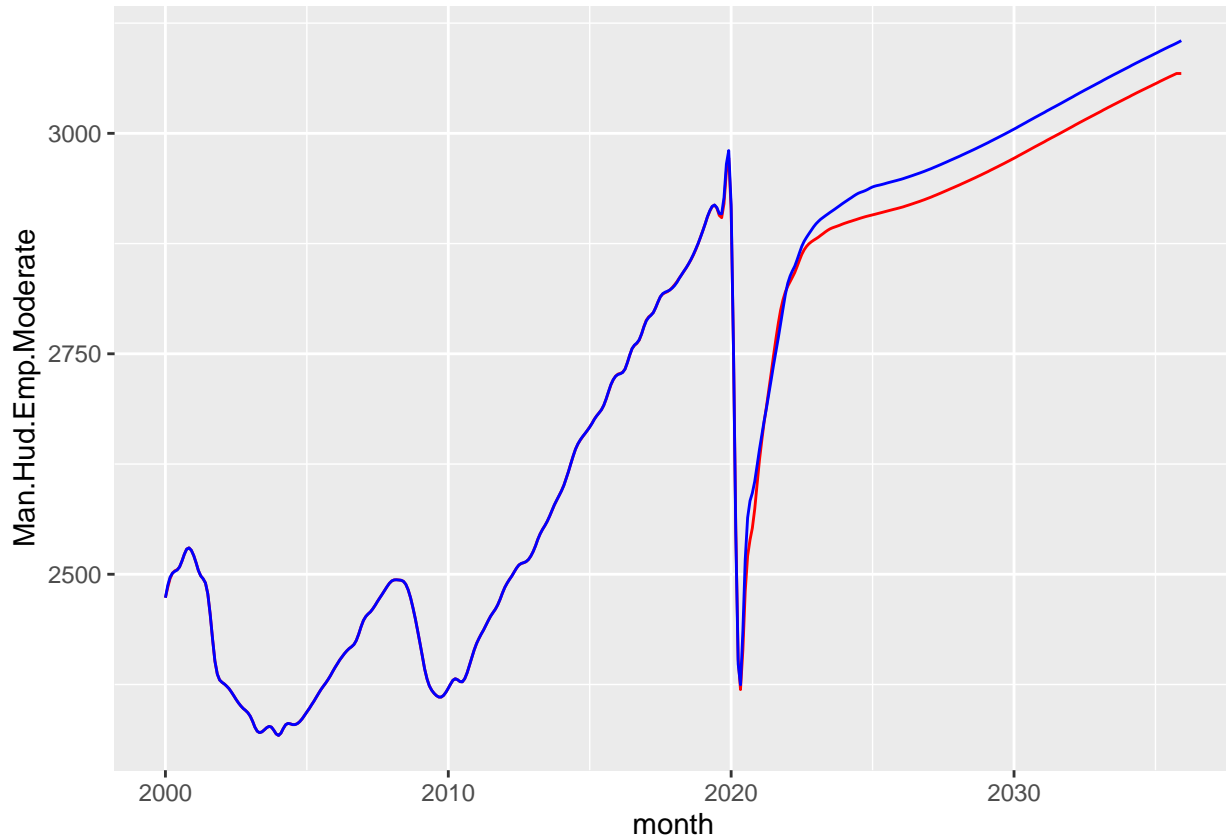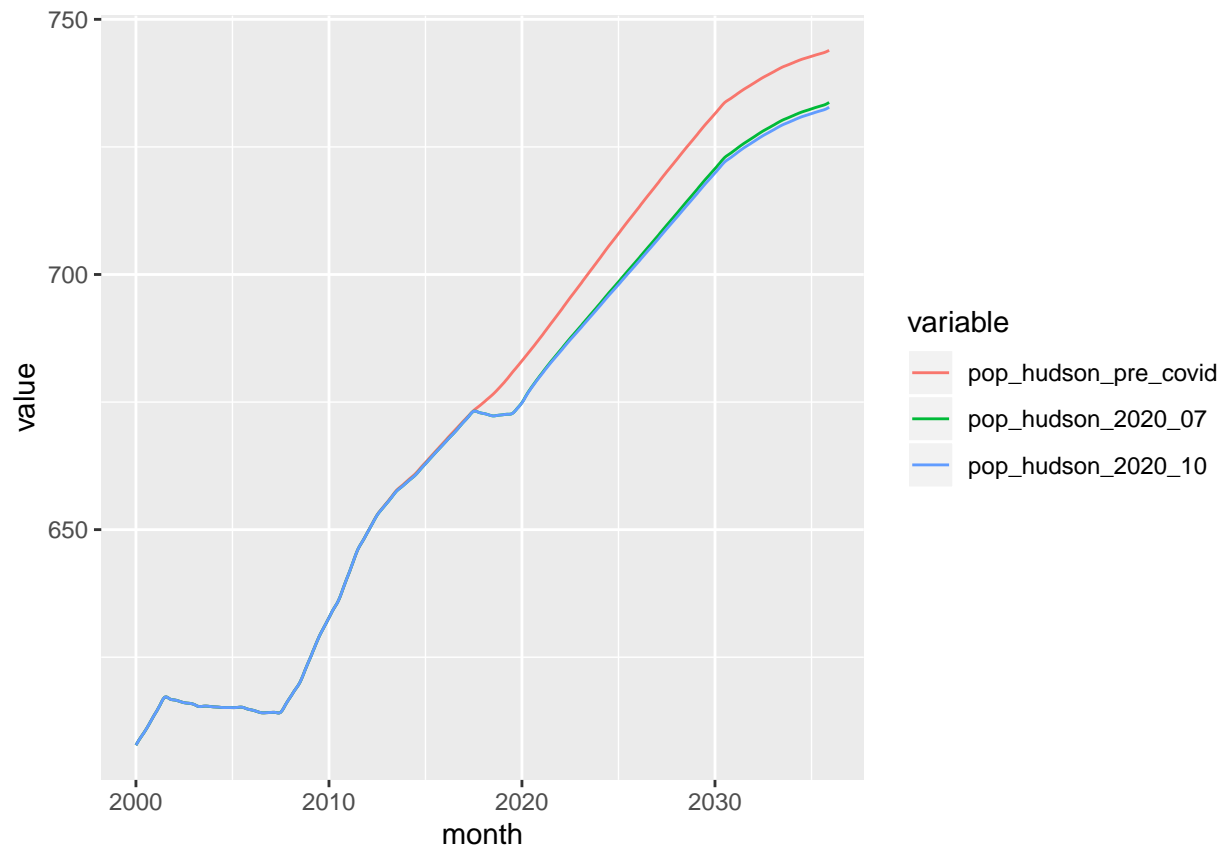


```
##       month              variable    value
## 1 2000-01-01 pop_hudson_pre_covid 607.7674
## 2 2000-02-01 pop_hudson_pre_covid 608.3153
## 3 2000-03-01 pop_hudson_pre_covid 608.8197
## 4 2000-04-01 pop_hudson_pre_covid 609.2940
## 5 2000-05-01 pop_hudson_pre_covid 609.7525
## 6 2000-06-01 pop_hudson_pre_covid 610.2143
```

```
path$cpi_base = path[path$month==end_cpi, #_cpi,
                     "cpi_2020_10"]# "cpi_2020_10"]
path$real_farefare = ifelse(path$month <= end_cpi, #_cpi
                            path$fare_nominal * path$cpi_base / path$cpi_2020_10, max(path$fare_nominal
path$cpi_base = NULL
```

```
before = subset(path, path$month <= end & path$month >= "2004-01-01")  #before = head(path, 218)
after = subset(path, path$month > end)  #after = tail(path, 250)
```

Models are trained below

Weekday:

```
fit = arima(ts(before$avg_wkdayholminor_tstile), xreg = oldreg,
    order = c(0, 0, 1), include.mean = T)
```

Saturday:

```
fitsat = arima(ts(before$avg_satholmajor_tstile), xreg = oldregsat,
    order = c(1, 1, 0))
```

Sunday:

```r
fitsun = arima(ts(before$avg_sun_tstile), xreg = oldregsat, order = c(1,
    1, 1))
```

Scenarios:

```r
# Scenarios
fit_pess = arima(ts(before$avg_wkdayholminor_tstile), xreg = oldreg_pess,
    order = c(0, 0, 1), include.mean = T)
```

```r
pathpredict = predict(fit, n.ahead = forec_horizon, newxreg = newreg)  # level=95 #interval = 'predicti
pathpredictsat = predict(fitsat, n.ahead = forec_horizon, newxreg = newregsat)
pathpredictsun = predict(fitsun, n.ahead = forec_horizon, newxreg = newregsat)
pathpredict_pess = predict(fit_pess, n.ahead = forec_horizon,
    newxreg = newreg_pess)
```

```r
pathpredict_by_month = as.data.frame(cbind(pathpredict$pred,
    pathpredictsat$pred, pathpredictsun$pred, pathpredict_pess$pred))
names(pathpredict_by_month) = c("avg_wkdayholminor_tstile", "avg_satholmajor_tstile",
    "avg_sun_tstile", "pess_wkdayholminor")
pathpredict_by_month$month = seq(as.Date(end) + extra, as.Date(future),
    by = "mon")
```

```r
# Annual
pathpredict_by_month$year = year(pathpredict_by_month$month)
pathpredict_year = summaryBy(sum_wkdayholminor + sum_satholmajor +
    sum_sun + sum_wkday_pess ~ year, data = pathpredict_by_month,
    FUN = sum)
names(pathpredict_year) = c("year", "base_wkday", "saturday",
    "sunday", "pess_wkday")
pathpredict_year$base_total = pathpredict_year$base_wkday + pathpredict_year$saturday +
    pathpredict_year$sunday
pathpredict_year$pess_total = pathpredict_year$pess_wkday + pathpredict_year$saturday +
    pathpredict_year$sunday
pathpredict_by_month$year = NULL
```

```r
resids = as.data.frame(cbind(as.vector(resid(fit)), as.vector(resid(fitsat)),
    as.vector(resid(fitsun))))
names(resids) = c("Weekday_residuals", "Saturday_residuals",
    "Sunday_residuals")
```

Output

```
##    year base_wkday saturday  sunday base_total pess_wkday pess_total
## 11 2030   76435427  8803875 5698222   90937523   75439440   89941536
## 12 2031   77009865  8887028 5741662   91638554   76010449   90639139
## 13 2032   77582188  9096490 5779157   92457836   76579168   91454816
## 14 2033   78136018  9037321 5811960   92985299   77129078   91978359
## 15 2034   78372689  9082973 5950427   93406089   77366116   92399516
## 16 2035   79189305  9123715 5878016   94191037   78164496   93166228
```

Save everything as:

```
sheets = list(Data = path, Monthly_Output = pathpredict_by_month,
    Annual_Output = pathpredict_year, Residuals = resids)
write_xlsx(sheets, "./output data/Output Scenarios 2020-10 moderate.xlsx")  # This exports and names th
```

Monthly output included in Excel file within output folder.

Modeling statistics and diagnostics

Weekday

Table 1: Weekday Coefficients

term	estimate	std.error
ma1	0.5885689	0.0472597
intercept	-66282.8096549	24208.0306321
before.man__hud__2020__10	128.8082213	14.1473484
before.dummy__2	6426.3833752	3404.9581196
before.dummy__3	8426.3166080	4546.8194630
before.dummy__4	13129.0593896	4569.6670840
before.dummy__5	15944.6678247	4566.1461631
before.dummy__6	19318.5073280	4563.9967523
before.dummy__7	15364.7767125	4563.2171791
before.dummy__8	9405.2947265	4563.2764879
before.dummy__9	19911.0093160	4563.7788051
before.dummy__10	17389.8455551	4565.3080363
before.dummy__11	10387.4286993	4652.6775874
before.dummy__12	-86.7781006	3487.5670831
before.dum__911__base	-23354.3800842	11597.6582535
before.supersandy	-73984.8135960	10357.4091916
before.real__farefare	-10856.5751517	6454.1838132

Table 2: Weekday Diagnostics

sigma	logLik	AIC	BIC
11163.28	-2073.108	4182.215	4240.943

Table 3: Weekday Additional Diagnostics

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	53.44718	11163.28	8430.106	-0.2850188	3.67054	1.126848	0.281867

Saturday

Table 4: Saturday Coefficients

term	estimate	std.error
ar1	-0.5585124	0.0605952
before.pop_hudson	523.2356968	656.5388125
before.dummy_2	6780.9739369	1793.5706560
before.dummy_3	20290.2898365	1658.3473168
before.dummy_4	22274.1010825	1994.6493893
before.dummy_5	14114.3369154	1988.9185426
before.dummy_6	21114.6613735	2107.8357937
before.dummy_7	17171.3505772	2082.3948583
before.dummy_8	15860.4076657	2120.3007649
before.dummy_9	16965.2121282	2000.5578066
before.dummy_10	20742.5909789	2017.0674087
before.dummy_11	15026.0441800	1702.8685613
before.dummy_12	15655.1356946	1858.0759241
before.dum_911_base	859.5471137	6278.9277089
before.supersandy	-44284.5835165	4171.7805266
before.end_close	-12898.1263046	2124.1972472
before.real_farefare	-24474.5145650	9613.6220782

Table 5: Saturday Diagnostics

sigma	logLik	AIC	BIC
6073.216	-1945.464	3926.927	3985.562

Table 6: Saturday Additional Diagnostics

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	60.05666	6057.478	4729.51	-0.1732135	4.461785	0.5574358	-0.1644578

Sunday

Table 7: Sunday Coefficients

term	estimate	std.error
ar1	-0.0445265	0.0876549
ma1	-0.7802932	0.0507924
before.pop_hudson	348.2850718	188.9506501
before.dummy_2	5187.6664455	1561.9745096
before.dummy_3	8015.3227558	1572.2248237
before.dummy_4	14026.8367673	1584.6169918
before.dummy_5	18530.2987652	1590.3228684
before.dummy_6	23939.1571614	1594.3957076
before.dummy_7	17486.9142618	1596.1529279
before.dummy_8	15939.3823386	1599.1928348
before.dummy_9	20933.3434954	1595.2401590
before.dummy_10	17503.7093505	1588.8364313
before.dummy_11	14105.5813536	1618.9627636
before.dummy_12	16602.4533573	1610.3012558
before.dum_911_base	-2979.4636967	5031.6430423
before.supersandy	-37398.6281660	3680.8730678
before.end_close	-10379.4860845	1411.3031702
before.real_farefare	-12158.1315694	5508.0072531

Table 8: Sunday Diagnostics

sigma	logLik	AIC	BIC
4882.906	-1903.732	3845.464	3907.356

Table 9: Sunday Additional Diagnostics

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	205.1011	4870.249	3560.601	-0.0636649	4.549924	0.5180944	-0.0101639

econ_month$month