PATH Forecast Documentation

Planning & Regional Development

8/17/2020

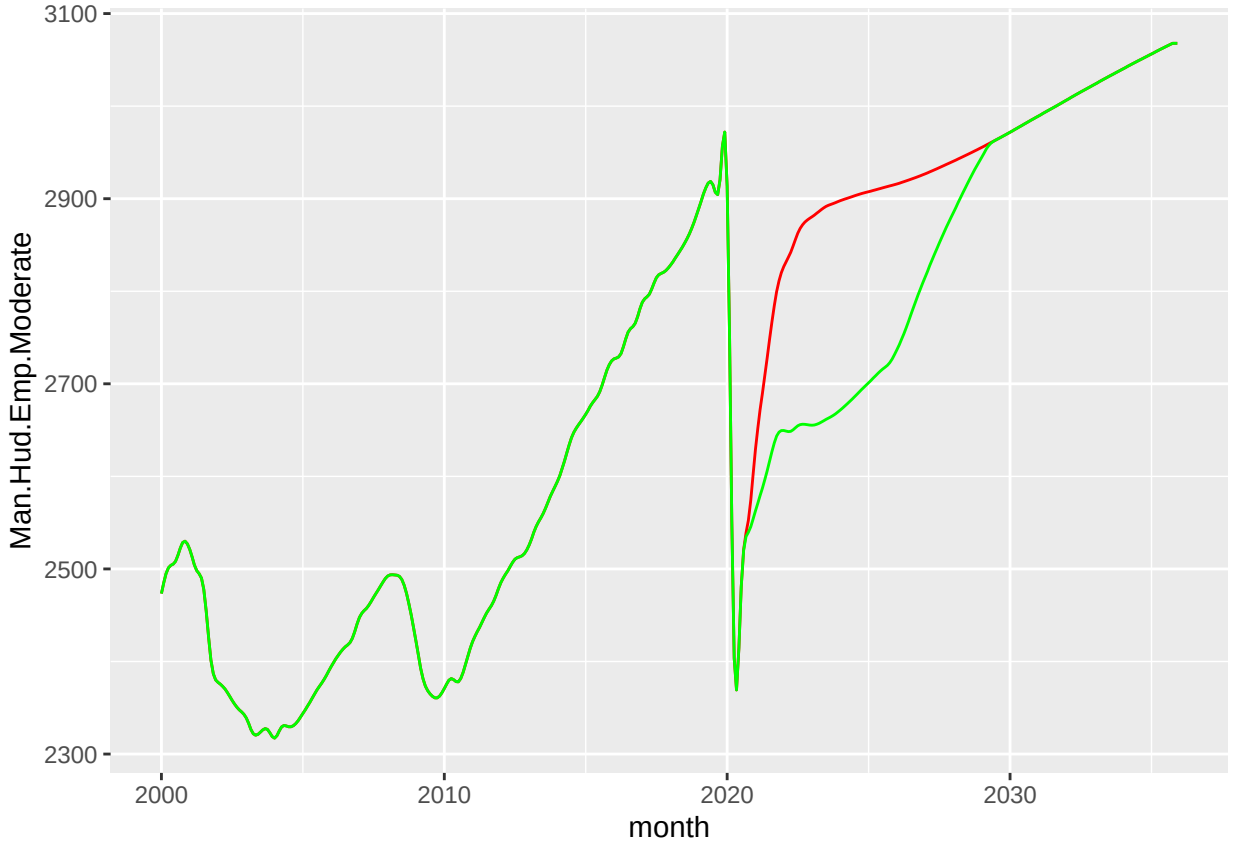
DRAFT

Summary

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

```
end = "2020-02-01"
end_and_one = "2020-03-01"
end_cpi = "2020-07-01"
```

```
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
```




```
path$cpi_base = path[path$month == end, "cpi_2020_08"]
summary(path$cpi_base)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   257.8   257.8   257.8   257.8   257.8   257.8
```

```
path$real_farefare = ifelse(path$month <= end, path$fare_nominal *
    path$cpi_base/path$cpi_2020_08, max(path$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:

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

Scenarios:

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

```
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)
```

```
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")
```

```
# 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
```

```
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

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 2020-08 PROTRACTED.xlsx")  # This exports and names
```

Monthly output included in Excel file within output folder.

Modeling statistics and diagnostics

Weekday

Table 1: Weekday Coefficients

term	estimate	std.error
ma1	0.5883296	0.0472607
intercept	-68011.4130772	24301.5016485
before.Man.Hud.Emp.Moderate	129.8369609	14.2046063
before.dummy_2	6401.3327322	3400.8716490
before.dummy_3	8402.6930235	4541.1612442
before.dummy_4	13139.5661027	4563.9157516
before.dummy_5	15946.9969942	4560.5626761
before.dummy_6	19312.5348702	4558.4511953
before.dummy_7	15367.0393762	4557.6325735
before.dummy_8	9416.6349339	4557.6330593
before.dummy_9	19952.6262925	4558.2255870
before.dummy_10	17437.0853440	4559.8490271
before.dummy_11	10416.2438391	4646.9361256
before.dummy_12	-64.3172662	3483.1869683
before.dum_911_base	-23288.7543338	11585.1502695
before.supersandy	-74028.6905107	10345.7394188
before.real_farefare	-11332.4425818	6526.4974685

Table 2: Weekday Diagnostics

sigma	logLik	AIC	BIC
11150.75	-2072.89	4181.781	4240.509

Table 3: Weekday Additional Diagnostics

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	53.22898	11150.75	8424.751	-0.2843659	3.667945	1.126132	0.282926

Saturday

Table 4: Saturday Coefficients

term	estimate	std.error
ar1	-0.5585051	0.0605963
before.pop_hudson	523.2218037	656.5501312
before.dummy_2	6779.3581573	1793.6486486
before.dummy_3	20288.3764994	1658.4246136
before.dummy_4	22272.5872928	1994.7136857
before.dummy_5	14113.9640778	1988.9839027
before.dummy_6	21114.1130151	2107.9100937
before.dummy_7	17171.8334205	2082.4951282
before.dummy_8	15860.1127556	2120.3909024
before.dummy_9	16964.9966244	2000.6590686
before.dummy_10	20741.9051513	2017.1482181
before.dummy_11	15027.4874859	1702.9422142
before.dummy_12	15655.3260011	1858.1078242
before.dum_911_base	859.9716267	6279.0057284
before.supersandy	-44282.9739524	4171.9608779
before.end_close	-12898.0323618	2124.2524659
before.real_farefare	-24681.6623549	9702.0141307

Table 5: Saturday Diagnostics

sigma	logLik	AIC	BIC
6073.391	-1945.469	3926.938	3985.573

Table 6: Saturday Additional Diagnostics

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	59.88329	6057.653	4729.704	-0.1733951	4.461986	0.5574587	-0.1644399

Sunday

Table 7: Sunday Coefficients

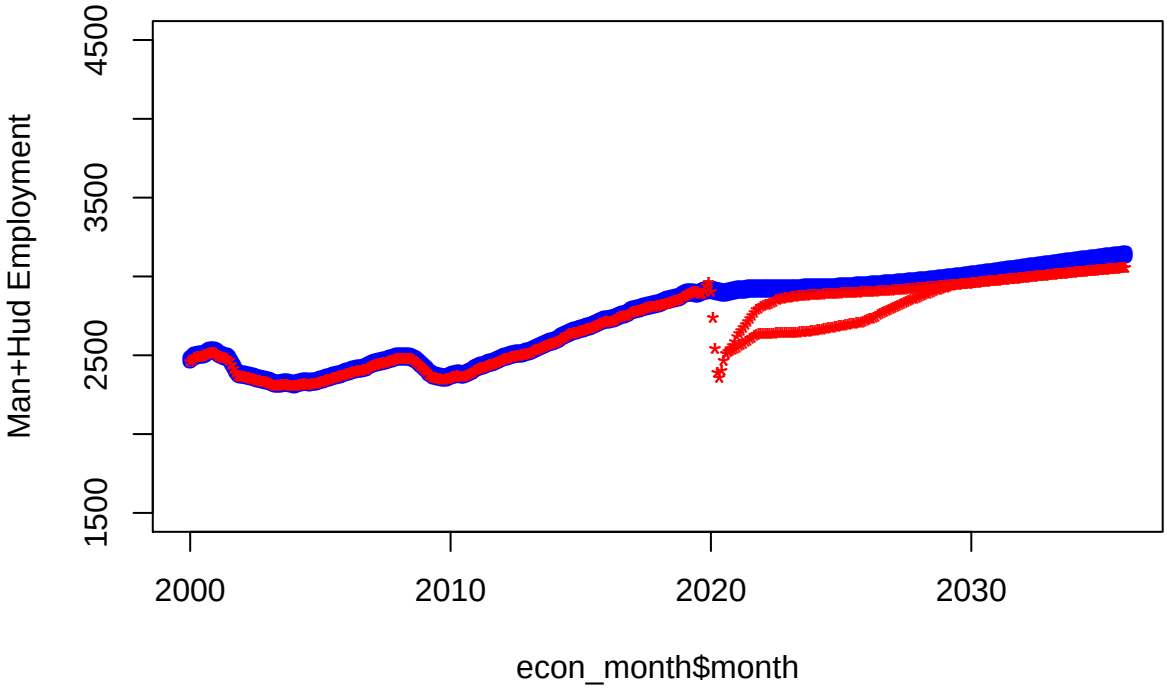
term	estimate	std.error
ar1	-0.0444993	0.0876532
ma1	-0.7803426	0.0507766
before.pop_hudson	348.2929829	188.9163537
before.dummy_2	5187.9343131	1561.9955824
before.dummy_3	8015.2865252	1572.2595082
before.dummy_4	14027.1115851	1584.6412404
before.dummy_5	18529.9009951	1590.3598071
before.dummy_6	23939.2594432	1594.4067781
before.dummy_7	17486.8404711	1596.1709534
before.dummy_8	15939.6089024	1599.2298931
before.dummy_9	20933.5924784	1595.2566719
before.dummy_10	17503.8318790	1588.8566445
before.dummy_11	14105.9792768	1618.9785639
before.dummy_12	16603.1600737	1610.3160126
before.dum_911_base	-2979.7179351	5031.6446009
before.supersandy	-37398.2263895	3680.9558501
before.end_close	-10379.3934099	1411.2612279
before.real_farefare	-12265.0660968	5557.9463042

Table 8: Sunday Diagnostics

sigma	logLik	AIC	BIC
4882.947	-1903.734	3845.467	3907.36

Table 9: Sunday Additional Diagnostics

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	205.012	4870.291	3560.669	-0.063786	4.550025	0.5181042	-0.0101412


Man+Hud Employment
1500
2500
3500
4500
2000
2010
2020
2030
econ_month$month