From:	Meridian
To:	EA
Subject:	RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx
Date:	Tuesday, 14 December 2021 4:48:48 pm
Attachments:	image001.png

Thanks!

From: S9(2)(a)
Sent: Tuesday, 14 December 2021 4:25 pm
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Here you go

From: S9(2)(a)
Sent: Tuesday, 14 December 2021 11:55 am
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Sorry, one more…
Both daily and Monthly for NZ?

From: S9(2)(a)
Sent: Tuesday, 14 December 2021 10:56 am
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Thanks for both. Could I get the monthly version of the storage classifications too?

From: S9(2)(a)
Sent: Tuesday, 14 December 2021 10:53 am
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

And here's the full output from the regression:

```
> ts.fit.s<-auto.arima(yreal,xreg=x1,d=0,trace=T)

Fitting models using approximations to speed things up...

ARIMA(2,0,2)(1,0,1)[365] with non-zero mean : Inf
ARIMA(0,0,0)            with non-zero mean : 27580.04
ARIMA(1,0,0)(1,0,0)[365] with non-zero mean : Inf
ARIMA(0,0,1)(0,0,1)[365] with non-zero mean : Inf
ARIMA(0,0,0)            with zero mean     : 27905.45
ARIMA(0,0,0)(1,0,0)[365] with non-zero mean : Inf
ARIMA(0,0,0)(0,0,1)[365] with non-zero mean : Inf
ARIMA(0,0,0)(1,0,1)[365] with non-zero mean : Inf
ARIMA(1,0,0)            with non-zero mean : 25566.59
ARIMA(1,0,0)(0,0,1)[365] with non-zero mean : Inf
ARIMA(1,0,0)(1,0,1)[365] with non-zero mean : Inf
ARIMA(2,0,0)            with non-zero mean : 25557.36
ARIMA(2,0,0)(1,0,0)[365] with non-zero mean : Inf
ARIMA(2,0,0)(0,0,1)[365] with non-zero mean : Inf
ARIMA(2,0,0)(1,0,1)[365] with non-zero mean : Inf
```

```
ARIMA(3,0,0)                     with non-zero mean : 25517.98
ARIMA(3,0,0)(1,0,0)[365] with non-zero mean : Inf
ARIMA(3,0,0)(0,0,1)[365] with non-zero mean : Inf
ARIMA(3,0,0)(1,0,1)[365] with non-zero mean : Inf
ARIMA(4,0,0)                     with non-zero mean : 25489.46
ARIMA(4,0,0)(1,0,0)[365] with non-zero mean : Inf
ARIMA(4,0,0)(0,0,1)[365] with non-zero mean : Inf
ARIMA(4,0,0)(1,0,1)[365] with non-zero mean : Inf
ARIMA(5,0,0)                     with non-zero mean : 25487.43
ARIMA(5,0,0)(1,0,0)[365] with non-zero mean : Inf
ARIMA(5,0,0)(0,0,1)[365] with non-zero mean : Inf
ARIMA(5,0,0)(1,0,1)[365] with non-zero mean : Inf
ARIMA(5,0,1) with non-zero mean : Inf
ARIMA(4,0,1) with non-zero mean : Inf
ARIMA(5,0,0)                     with zero mean     : 25582.65

Now re-fitting the best model(s) without approximations...

ARIMA(5,0,0)                     with non-zero mean : 25485.19

Best model: Regression with ARIMA(5,0,0)            errors

> summary(ts.fit.s)
Series: yreal
Regression with ARIMA(5,0,0) errors

Coefficients:
         ar1      ar2     ar3     ar4     ar5   intercept     stor    ddema
windgen    gasp   dd$dummy
      0.6908  -0.0222  0.0492  0.0788  0.0422    67.1521   -0.0613   0.6843
-6.2694  3.0827    38.7415
s.e.  0.0196   0.0233  0.0234  0.0233  0.0193     4.3000    0.0071
0.0690  0.4482   0.3579    6.3678

sigma^2 estimated as 648.6:  log likelihood=-12730.54
AIC=25485.08   AICc=25485.19   BIC=25556.05

Training set error measures:
                     ME      RMSE       MAE       MPE       MAPE
MASE         ACF1
Training set 0.02991869 25.42045 15.43852 -6.96375 20.37792 0.3191178
-0.003173815
> coeftest(ts.fit.s)

z test of coefficients:

          Estimate Std. Error  z value  Pr(>|z|)
ar1       0.6908303  0.0196128  35.2234 < 2.2e-16 ***
ar2      -0.0222353  0.0232970  -0.9544 0.3398685
ar3       0.0492194  0.0233603   2.1070 0.0351204 *
ar4       0.0787666  0.0232983   3.3808 0.0007228 ***
ar5       0.0421510  0.0192869   2.1855 0.0288539 *
intercept 67.1521260  4.3000135  15.6167 < 2.2e-16 ***
stor     -0.0613012  0.0070631  -8.6791 < 2.2e-16 ***
ddema     0.6843069  0.0690112   9.9159 < 2.2e-16 ***
windgen  -6.2693744  0.4481960 -13.9880 < 2.2e-16 ***
gasp      3.0826903  0.3579049   8.6132 < 2.2e-16 ***
dd$dummy 38.7415274  6.3678304   6.0839 1.173e-09 ***
--
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

From: S9(2)(a)

Sent: Tuesday, 14 December 2021 10:30 am

To: S9(2)(a)

Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hi S9(2)(a) ,

There is no R-squared output for ARMA models, see:

https://stats.stackexchange.com/questions/8750/how-can-i-calculate-the-r-squared-of-a-regression-with-arima-errors-using-r

Attached is the csv for Pukaki, Taupo and Tekapo storage.

From: S9(2)(a)
Sent: Tuesday, 14 December 2021 9:55 am
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Thanks again.

A couple (hopefully) last ones:
Can I get the same 0/1/2 daily and monthly for Taupo/Pukaki/Tekapo? I'm getting some differences in some of the other tables and it would be good to identify if it is input data or methodology.

Do you have the full output from the Regression? R^2 etc? With some of the input data being only held by you I can't re-run it myself.

Ngā mihi,

From: S9(2)(a)
Sent: Tuesday, 14 December 2021 8:29 am
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Yip sure do

From: S9(2)(a)
Sent: Monday, 13 December 2021 4:03 pm
To S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Thanks, do you get $76.206250 on 2016-01-05?

Ngā mihi,

From: S9(2)(a)
Sent: Monday, 13 December 2021 3:49 pm
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Here's my query and data manipulation code if that helps:

```
Q=r"""
SELECT [Settlement_Date],
        [Settlement_Price],
    [Expiration]


  FROM [ForwardMarkets].[Conf].[NZ_CLOS_SNAPSHOT_Electricity]

 --where Condition='BEN_QTR_BASE_FUT' and Settlement_Date is not null
  where Condition='BEN_QTR_BASE_FUT' and Settlement_Date is not null
 and [Settlement_Date]< "%s"

 order by Settlement_Date , Expiration
   """ %(now)

warehouse= db.query(Q)
warehouse['TradingDate']=pandas.to_datetime(warehouse.Settlement_Date, dayfirst=True)
del warehouse['Settlement_Date']
warehouse = warehouse.sort_values(['TradingDate','Expiration'])
warehouse.set_index([ 'TradingDate', 'Expiration'], inplace=True)
warehouse2 = warehouse.groupby(level=0).mean()
```

From: S9(2)(a)
Sent: Monday, 13 December 2021 3:47 pm
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Ahh, darn ☹ I'm sure we keep that data so I'll go hunt it down.
Just to confirm that for each Trading Day the ASX is the arithmetic mean of all Quarter contracts being traded on that day?

From: S9(2)(a)
Sent: Monday, 13 December 2021 3:26 pm
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hi S9(2)(a),
We are not allowed to share ASX data externally (the terms of our subscription explicitly forbid that).
Regards,
S9(2)(a)

From: S9(2)(a)
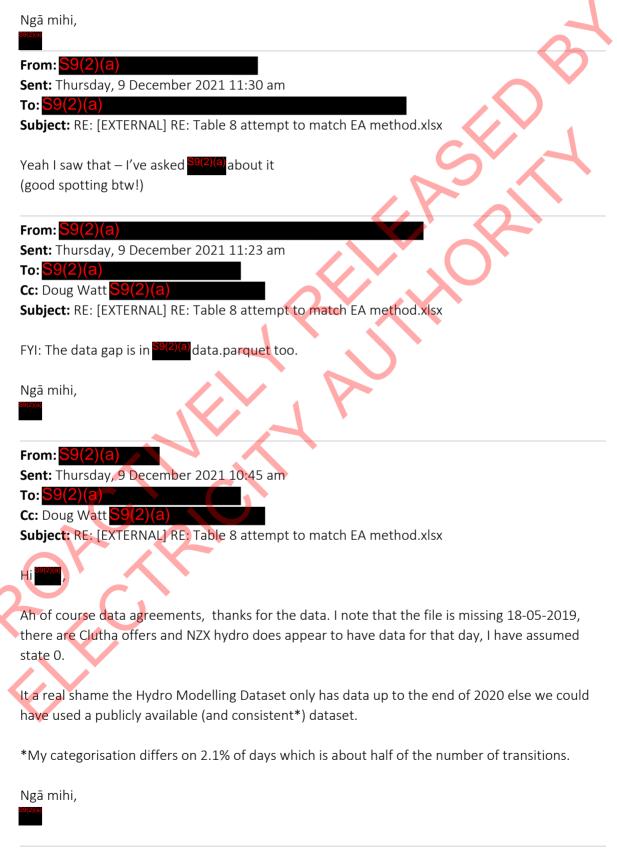**Sent:** Friday, 10 December 2021 2:11 pm
To: S9(2)(a)
Subject: RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx
```

Hi Julia,

I assume Lerner Index values were allocated to a month based on the average storage during the month, can you please send me the monthly Clutha classifications?
Also to save me some work, do you have the data you used for the average forward price (e.g. for Table 10)?

Ngā mihi,
S9(2)(a)

**From:** S9(2)(a)
**Sent:** Thursday, 9 December 2021 11:30 am
**To:** S9(2)(a)
**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Yeah I saw that – I've asked S9(2)(a) about it
(good spotting btw!)

**From:** S9(2)(a)
**Sent:** Thursday, 9 December 2021 11:23 am
**To:** S9(2)(a)
**Cc:** Doug Watt S9(2)(a)
**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

FYI: The data gap is in S9(2)(a) data.parquet too.

Ngā mihi,
S9(2)(a)

**From:** S9(2)(a)
**Sent:** Thursday, 9 December 2021 10:45 am
**To:** S9(2)(a)
**Cc:** Doug Watt S9(2)(a)
**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hi S9(2)(a),

Ah of course data agreements,  thanks for the data. I note that the file is missing 18-05-2019, there are Clutha offers and NZX hydro does appear to have data for that day, I have assumed state 0.

It a real shame the Hydro Modelling Dataset only has data up to the end of 2020 else we could have used a publicly available (and consistent*) dataset.

*My categorisation differs on 2.1% of days which is about half of the number of transitions.

Ngā mihi,
S9(2)(a)

**From:** S9(2)(a)

**Sent:** Thursday, 9 December 2021 8:25 am

**To:** S9(2)(a)

**Cc:** Doug Watt S9(2)(a)

**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hi S9(2)(a),

Sorry I'm not allowed to share the raw storage data with you due to our agreement with NZX Hydro. The attached csv has for each trading period whether (using NZX hydro storage data – the sum over Hawea, Wakatipu, and Wanaka) storage was:

0: between 80% and 100% of monthly mean

1: less than 80% of monthly mean

2: greater than or equal to 100% of monthly mean

I hope that helps.

S9(2)(a)

---

**From:** S9(2)(a)

**Sent:** Wednesday, 8 December 2021 10:55 am

**To** S9(2)(a)

**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hey S9(2)(a),

Just the raw storage data (for all catchments) that you used would be great, one of the tests I may be asked to analyse is "what if a different measure of storage was used" so I need to be sure that any changes are only due to that difference rather than a difference in, for example, what 0 GWh of storage is.

Thanks

S9(2)(a)

---

**From:** S9(2)(a)

**Sent:** Wednesday, 8 December 2021 9:28 am

**To:** S9(2)(a)

**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hey S9(2)(a),

So you want the daily values of the percent of offers above $300/MWh for Clutha? (maybe with a column indicating whether that day is a 'high' or 'low' storage day?

S9(2)(a)

---

**From:** S9(2)(a)

**Sent:** Tuesday, 7 December 2021 4:04 pm

**To:** S9(2)(a)

**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hi S9(2)(a)

I have managed to replicate your Table 8 values (same integer values) but CLUTHA is giving me very different values and my rounding is slightly different here and there. Could you send me the values you used (either the daily % by storage or the data you used to calculate them)?

Thanks,
S9(2)(a)

**From:** S9(2)(a)
**Sent:** Thursday, 18 November 2021 4:25 pm
**To:** S9(2)(a)
**Subject:** RE: [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hi,

I only saw the first DOASA folder, I'll look through the rest. Thanks

Ngā mihi,
S9(2)(a)

**From:** S9(2)(a)
**Sent:** Thursday, 18 November 2021 4:13 pm
**To:** S9(2)(a)
**Subject:** [EXTERNAL] RE: Table 8 attempt to match EA method.xlsx

Hey S9(2)(a),

**From:** S9(2)(a)
**Sent:** Thursday, 18 November 2021 12:44 pm
**To:** S9(2)(a)
**Subject:** Table 8 attempt to match EA method.xlsx

H S9(2)(a),

I've been attempting to get the same values for Table 8 in Market-Monitoring-Review-of-Structure-Conduct-and-Performance-in-the-Wholesale-Electricity-Market-Information-Paper.pdf but I get different values.

I have calculated the mean storage using NZX hydro data for each month (Q10-X23) then divided the storage on a given day by the appropriate monthly mean (J:O).
I get slightly different values for monthly storage (I get the monthly average from 1 Jan 1926 to 3 Sept 2021) – eg, January I get 1268.88 for Pukaki, you get 1265.166) – doesn't effect the storage figures much though.

I have calculated the fraction of offers greater than or equal to $300 for each of the blocks (SUM above/SUM total) for each trading period (C:H).
I get different figures for this – see below. Have you used the rogersdata.parquet file that I put up on EMI? (ie, effective offers – adjusted for reserves and FK)

| Megawatt | | TotMW | percent |
| --- | --- | --- | --- |
| **TradingDate** | **TradingPeriod** | | |
| **2014-01-01** | **1** | 439.313 | 1356.313 | 32.390237 |
| | **2** | 450.825 | 1351.825 | 33.349361 |
| | **3** | 442.055 | 1347.055 | 32.816403 |
| | **4** | 490.522 | 1367.522 | 35.869405 |
| | **5** | 513.509 | 1369.509 | 37.495847 |

I then calculated the average of the averages where storage is below 80%/80-100%/above 100% for each of 2014 – Sept 2018 and 2019 - June 2021.(Q2-X8).

Can you please check my values against yours to point out where my replication diverts from your method.

Thanks,

S9(2)(a)

S9(2)(a) – **Systems Modeller**
Meridian Energy Limited
Level 2, 55 Lady Elizabeth Lane, PO Box 10840
Wellington 6143, New Zealand
M. S9(2)(a)

action in reliance upon this transmission."

"The information contained in this transmission is confidential. It is intended for the named addressee only. If you are not the named addressee you may not copy, distribute or take any action in reliance upon this transmission."

"The information contained in this transmission is confidential. It is intended for the named addressee only. If you are not the named addressee you may not copy, distribute or take any action in reliance upon this transmission."

"The information contained in this transmission is confidential. It is intended for the named addressee only. If you are not the named addressee you may not copy, distribute or take any action in reliance upon this transmission."

"The information contained in this transmission is confidential. It is intended for the named addressee only. If you are not the named addressee you may not copy, distribute or take any action in reliance upon this transmission."

"The information contained in this transmission is confidential. It is intended for the named addressee only. If you are not the named addressee you may not copy, distribute or take any action in reliance upon this transmission."