Thanks for attending this session.

Today I talk about trend adjusted exponential smoothing, or double exponential smoothing, or what which is referred to as Holt Method.

The simple exponential smoothing understates or overestimates if there is a trend in data.

If the trend in the data is upward, simple exponential smoothing underestimates the demand.

If the trend in the data is downward, simple exponential smoothing overestimates the demand.

That is how I set the stage to move from simple exponential smoothing to trend adjusted exponentials

let's quickly do simple exponential smoothing for a given alpha.

Lets assume the intercept of the regression line as forecast for the first period.

We could have also assumed the actual of the first period as forecast for the first period.

But lets stay with the intercept of the regression line.

Lets use alpha =0.5

Forecast for period 2 = (1-alpha) times forecast for the previous period plus

Alpha times the actual for the previous period.

That would be our forecast for the next period.

For forecast in period 3 and the rest of the periods we simply copy down what we have for forecast in period 2.

Since here we have upward trend, forecast continually underestimates the demand.

If you draw tracking signal for this forecast, the graph will be a little surprising, it is a straight line going 1, 2, 3, 4, …..

interesting observation here we will have for tracking signal equal to bias by

matt if error let me leave it as a space and then

i will copy down look at here this is a very funny observation if

our forecast always underestimates the demand then

tracking signal would be a straight line with the slope of one

exponential smoothing and i will explain

Now lets check the regression line. We have already computed the INTERCEPT, and lets compute the slope.

And draw the regression line

It is better that simple exponential smoothing.

Lets see if we can perform better

Lets refer to interxcept as liver and refer to sloe as trend

We could have chosen a sifferent approach to compute level and trend

We could have set level equall to the actual in the fist period and trend as the diference between the actual of the last period minus rge actual of the first period divided by the number of periods minus 1

In that case we had level in period 0 = 19 and trend in period 0 = (86-19)/(28-1) = 2.48

But we stay with level = intercept = 17.79 17.79 and trend = slope = 1.99

everything

step by step

first we need a level and i assume the

first one as my level

then for trend

i

take the

last one

i subtract it from the first one

and i divide it by the number of periods

minus one because if you have

1 2 3 4 pieces of data if this is 2

and this is 9 if you want to find these

gaps

9 minus 2 not divided by

but divided by 3 so that would be 7

divided by 3 that would be our

trend

so what i have done

here

is simply equal to this one

and then

equal to the last one minus the first

one divided by number of pieces of data

and i think here i have

28 pieces of data and therefore i divide

it by 27

enter

okay now first let me

change this alpha

and beta

2.5 and 0.5 just for simplicity

my forecast for the next period would be

equal to level

plus

trend

therefore

this forecast is level

plus three now the question is how do i

update level and how do i update

trend it is very similar to simple

exponential smoothing

for level

we have the previous formula

1 minus alpha times something which we

call it

forecast

plus alpha times

what we call it actual

the same is for trend equal to 1 minus

beta times something that we call it

forecast for trend plus

beta times

what we call it actual for trend

forecast for next period is equal to

level

plus trend

now i need to compute this new level i

compute it using this actual

and this forecast

exactly as before so it would be equal

to

minus

alpha and i like it because i need to

copy down multiply by

forecast

plus oliver

and i like it multiplied by

actual an actual that i have observed in

this period is over there in b3 the same

as previous i use this one

as forecast and this one

actual these will become a little bit

more complicated when we go to trend and

seasonality adjusted exponential

smoothing but for this one is exactly

the same as what we did for simple

exponential smoothing i'll go here and

for trend

one minus beta

and i like it

multiplied by

1 minus is always multiplied by forecast

and our forecast for trend was this one

multiplied by

this one

plus beta

and this is my beta and lock it

multiplied by

actual no actual is what for actual we

take

this level which was here

and subtract it from this level current

level minus previous level so i come

here

this is my current level and my previous

level was this one enter

now i do have level and trend forecast

equal to level plus trend

okay now i have

this number and this number in period

two and i should compute level and trend

and then forecast for period three and

then i can do click click and copy

everything down so i'll go back again

here

just for your practice equal to one

minus alpha

and lock it

one minus

is always multiplied by forecast my

forecast here is this one plus alpha

and lock it

multiplied by actual actually i am in

period 2

and it is over there

enter that is my level

now for

trend

i should take

my forecast for trend which is this one

and multiply it by 1 minus beta and then

i get this level

subtract it from the previous level and

that is

what i have observed

and multiplied by beta and that's it

equal to

1 minus beta

and lock it multiplied by

forecast for trend which is this one

plus

beta

and lock it

multiplied by

level in period two

minus

level in period one

that's it

now i do have everything i can go with

there and copy this

down

Finding Alpha and Beta

i do have my trend adjusted exponential

smoothie

the only thing is i need to

find the best alpha and beta and there

are two ways to do it

solvent and data table

and i have

put the formulas here for you this is

formulas for

visceral that's why i have painted them

to say

what is going where

this is formula for this row

i type

and then i type

and i go here i type 0

and i type

so now i have 0

to 1

here i also have 0 to 1 this is alpha

and this is

beta equal to actual

minus

forecast

and here

equal to

this one

squared i could have done it in the same

here place

my

e2

all i need here to compute msc

equal to

average

of

this one

to itself and i put a dollar sign in

front of

three

and that is

it

here is my last mse

so i go up

i set this equal to

here is my

msc

that's it enter

i market

data

what if analysis

data

table what is in the row in the row here

i have my beta

what is in the column here

i have my

alpha

and

i fill it

so i have the minimum here

that is the minimum of these numbers

conditional formatting

highlights souls

equal to if that is

equal to this

paint it

and then

i do this format paint

and

now i know where my minimum is

for alpha it is around 0.8 so i'll go

here

i point this 1.75

and then i make this one

point

over

and four

i think i should start from point

seven eight

and then for beta it is between

point

forty five

and here i make it

so i was able to find alpha and beta

with two decimal points i can move

forward because here i have

a base and i have increment and then i

have come here and i

typed

equal to

this one

and then i have typed

equal to

this one

plus

this one

and locate

enter

and then i have

copied to the right

and here i have equal to

this one

and here equal to

this one

plus

this one

i have locked it

down here and that is my mse my beta is

about 0.51

and my alpha is about

i can also go to solver data

solver

minimize

mse

by changing

alpha and beta

and

all for

less than or equal to one

hat

all for

greater than or equal to

zero at

beta

less than or equal to

one

and beta

greater than

or equal to

zero

okay

solve

thank you

and we can now check the

solutions that we have found

using solver

point 84.84

51.50 we can apply the same procedure on

Computation

math

msemap and so on and so forth let me

quickly compute everything equal to apps

of this one enter

equal to

apps

divided by

actual

med i just take this one copy and paste

it ctrl b

and then that would be e average of e to

itself

and then

m a p e i just

copy this

to the right double click on it

and that is already

average of this and the first one is

already locked

biased equal to summation

of the errors

which is

here

to

itself

and i put the dollar sign

here

enter

and tracking signal is equal to

is divided by

math

enter

and now i can

take everything

and copy them down

Mistake

now i have all the computations

i can go here for example

instead of setting this equal to

mse which was here i can set it equal to

mkd

oops i think i have made a mistake

for m80 because

mad cannot be negative i should bring it

okay

let me see

okay

oh i have a negative

sign here

my mistake

so i have everything over here

and

i can go right there

double click i need and set it

equal to

m-a-d

now

i can go back

i can set this one equal to zero again

set this one equal to point one

this one equal to zero

this one equal to point one

and now i know it is here in this range

0.45 for example

and

point

o 1 and then

here

is between point

75 and something i'll go over there

then add to it

this point 55 is too much

let i'm in too little

me make it .49

so the

best

alpha format

is

and best beta for math is point 56

Forecast

and now we want to forecast for the next

periods

it's equal to

level

plus

trend

enter

equal to

this one

plus

trend

and then we copied them

i could have also said

equal to

level

plus

the difference between

to forecast for

future periods of

and 32.

i'll come here equal to

this one

plus

this one

and

lock it

enter

equal to this one

plus

this one and like it it didn't matter if

i didn't lock the previous one

and then i can copy down alternatively i

could have come here and said equal to

this one

and lock it

plus

the difference between this one

and this

base and lock the base

multiplied by

trend and lock the thread

enter

up it down

and down

and

thank you very much