

Stat 565

Welcome

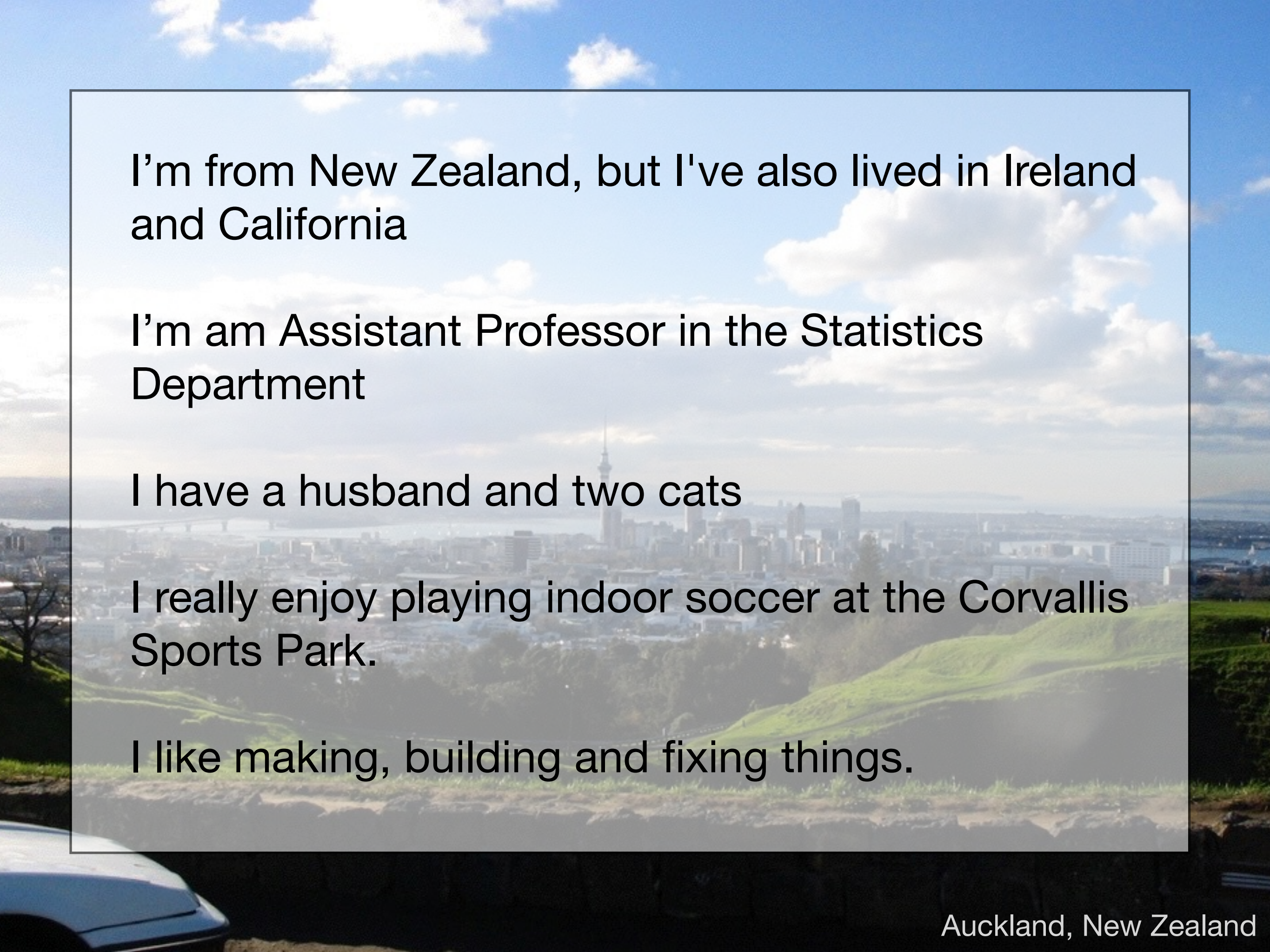
Jan 5 2016

Charlotte Wickham

stat565.cwick.co.nz

Hello, my name is

Charlotte



I'm from New Zealand, but I've also lived in Ireland and California

I'm an Assistant Professor in the Statistics Department

I have a husband and two cats

I really enjoy playing indoor soccer at the Corvallis Sports Park.

I like making, building and fixing things.

Your turn

Look south

Introduce yourself to your neighbour

Why are you taking ST565?

stat565.cwick.co.nz

My lecture style

I will generally use slides

I will get you to do things: "Your turns"

Everything will go on the website

Spend lecture listening, thinking, doing and talking not writing down my every word.

Syllabus

<http://stat565.cwick.co.nz/syllabus.html>

Textbook:

You will need to do some reading outside of the lecture notes. I'll be following:

The Analysis of Time Series: An Introduction, Chatfield C.

Available online through OSU library.

Fourth, Fifth or Sixth editions will all probably be ok.

Alternatively, have a look at the other (free) books on the syllabus

Assessment:

40% homework + 20% project + 20% midterm + 20% final

Cheating is bad!

Talk to me if you need disability accommodations.

Prerequisites

ST 511 & 512 + ST 521 & 522

R + Regression + Basic math stat

Test yourself @

<http://stat565.cwick.co.nz/prereqs.html>

You should have a recent version of R installed (> 3)

Consider using RStudio:

<http://www.rstudio.com/ide/download/>

Midterm

Tentatively Thursday of week 6, and will focus on these learning outcomes:

- Define the concept of stationarity and describe its importance in time series analysis.
- Define basic stationary time series models: white noise, AR(1) and MA(1).
- Define the autocovariance and autocorrelation functions and derive the autocorrelation function for basic time series models.
- Apply the Box-Jenkins modelling approach to identify, fit, check and forecast SARIMA models for time series data.

Homework

About one homework a week.

Assigned Thursday, due following Thursday in class.

First homework assigned Thursday.

Project

Proposal due week 7... more details closer to the time.

It should be entirely your own work and not used for credit in any other class.

Getting help

See me in office hours (255 Weniger):

Mon & Wed 1-2pm

or by appointment

(ST552 office hours Tue & Thu 2-3pm)

See Chris Comiskey (TA) in office hours:

TBA

Questions on the syllabus?

Thursday

Bring a laptop, if you can!

What is a time series?

A variable measured sequentially at
fixed intervals of time.

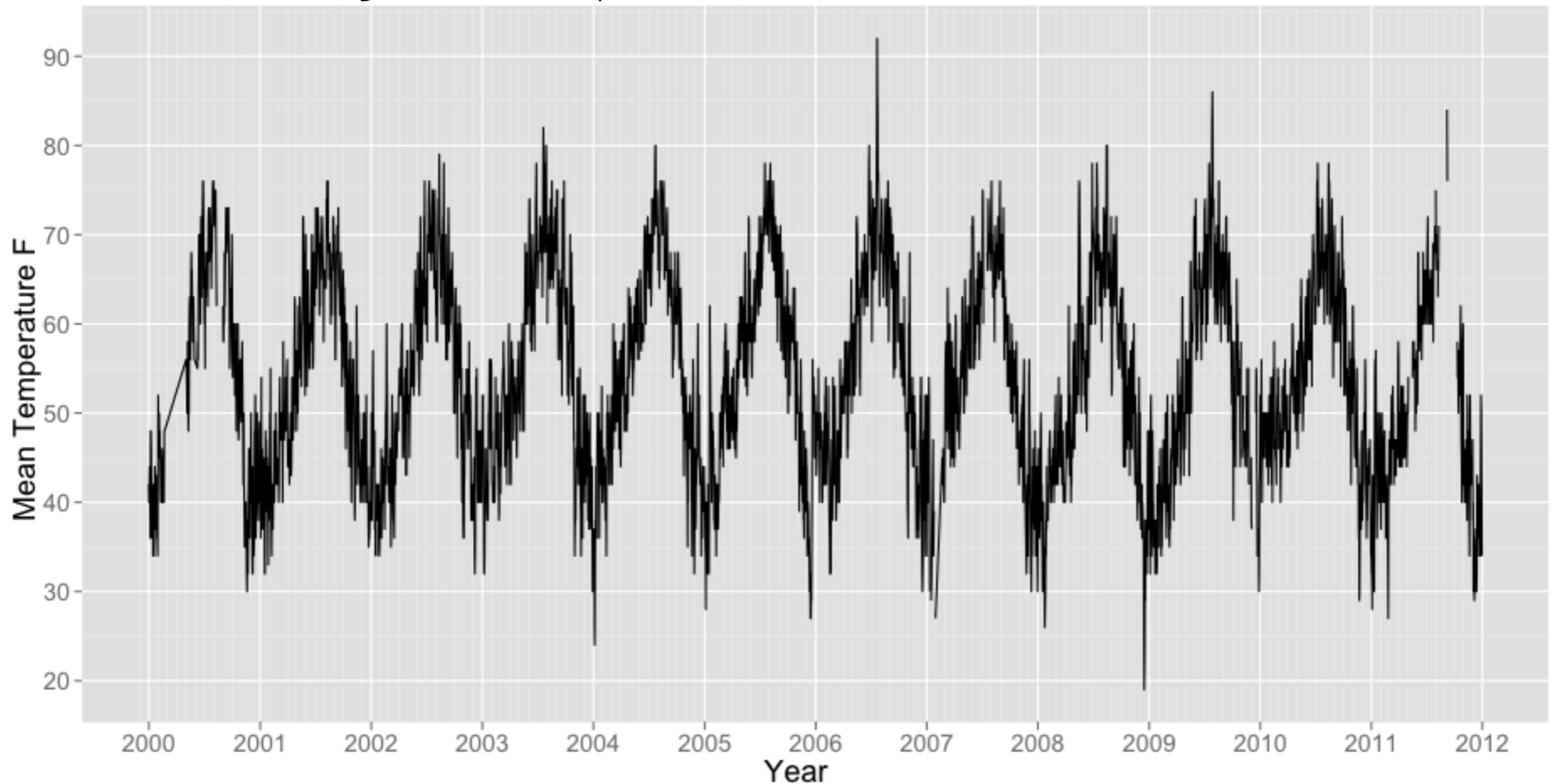
often equispaced

What's the big deal?

Measurements are often correlated in
time (aka serial dependence).

We can't rely on methods that assume independence.

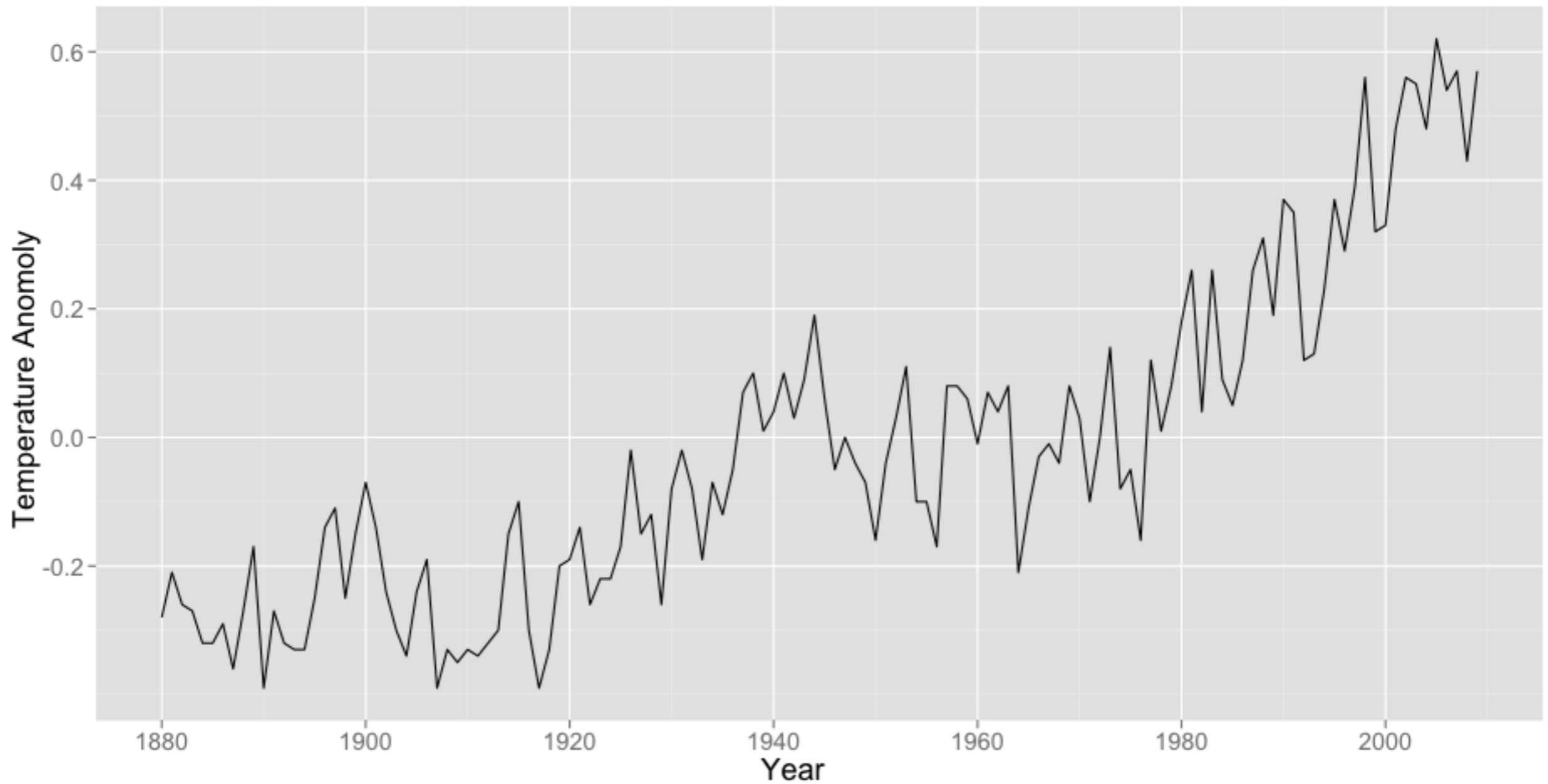
Daily temperature in Corvallis



What does the average year look like?

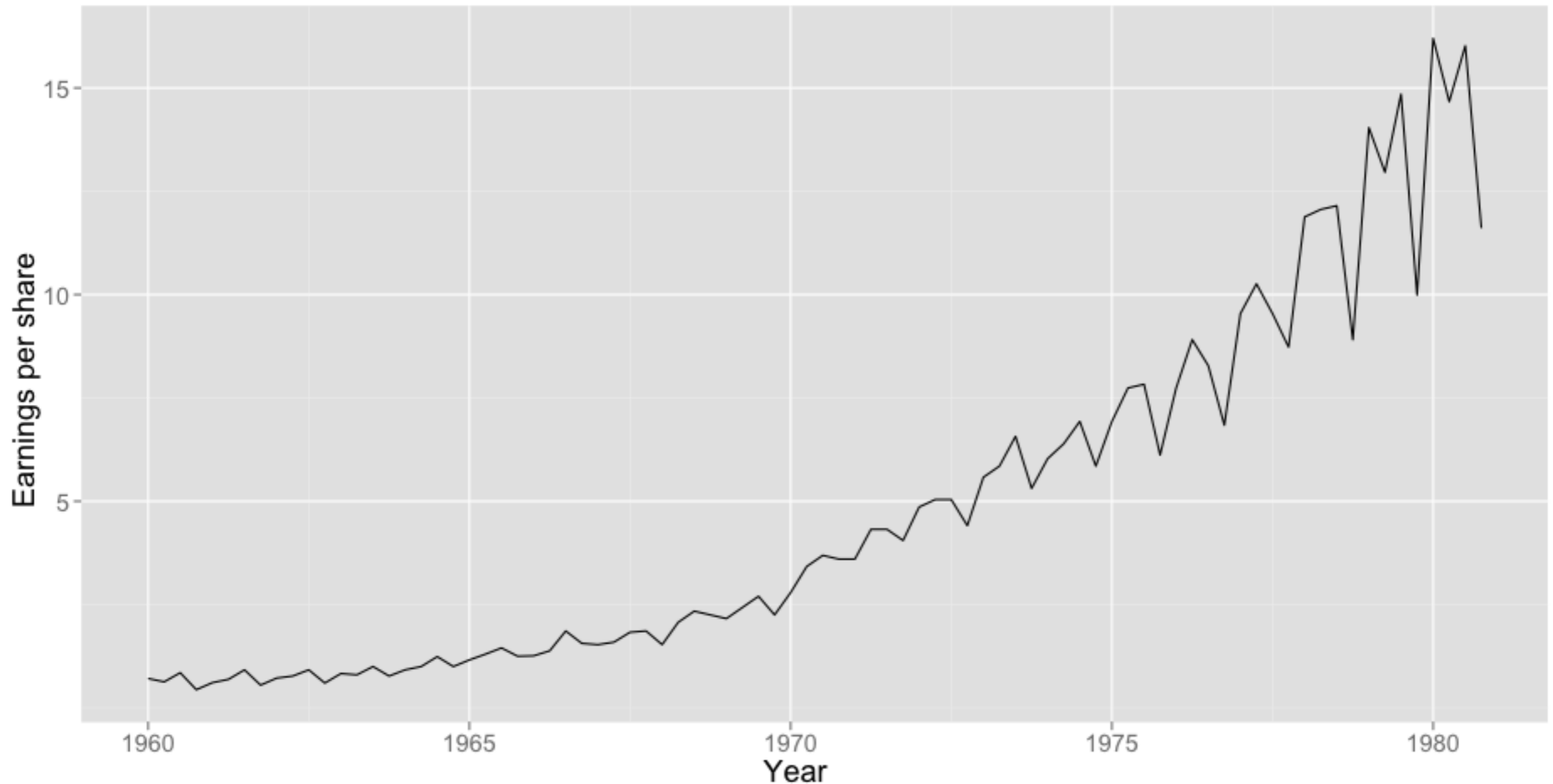
Has it been getting hotter or colder?

Monthly global average temperature



Is it getting hotter?

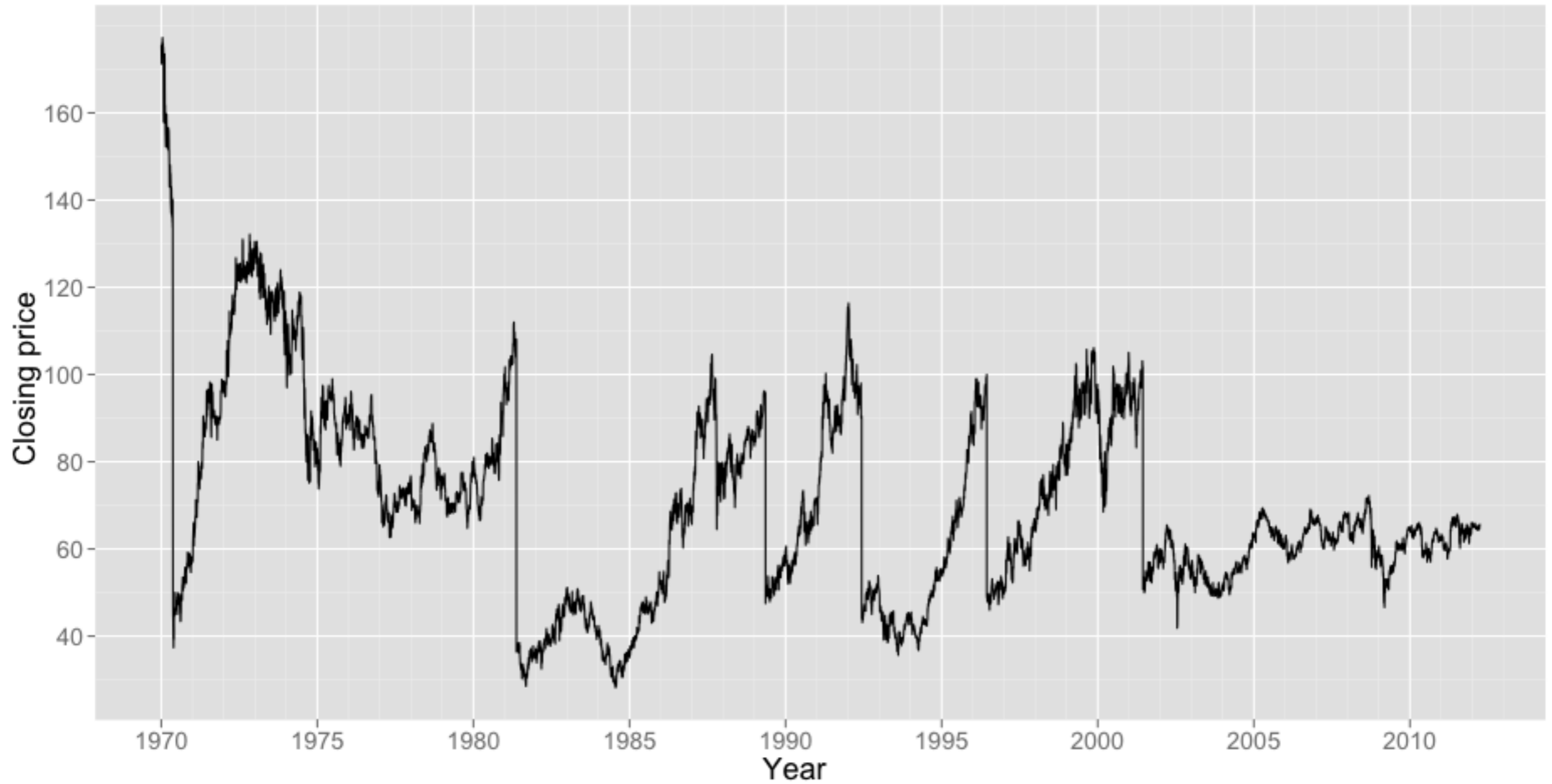
Quarterly earnings for Johnson & Johnson



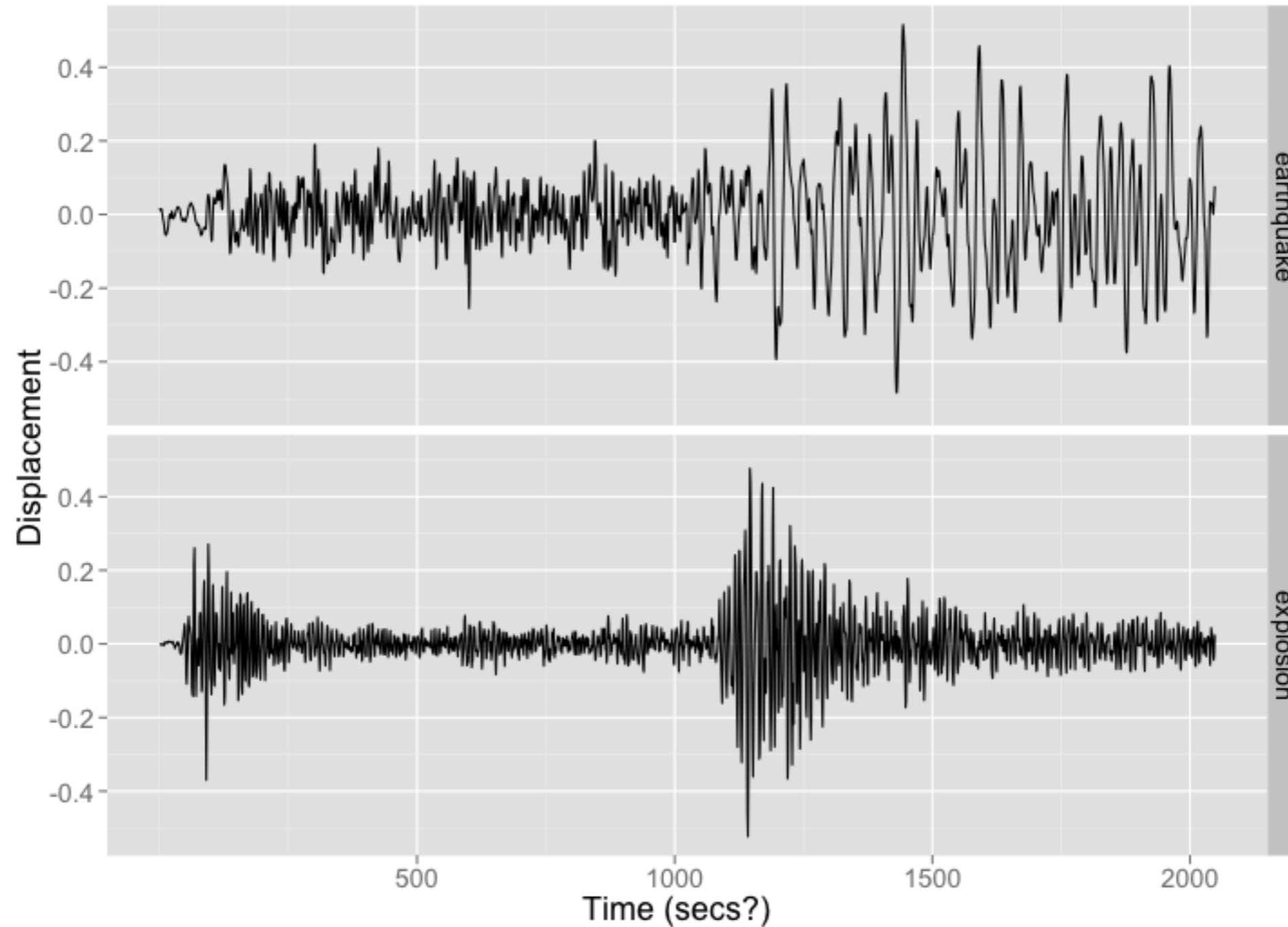
What are the forecast earnings for Q1 1981?

What are the forecast earnings for Q4 1981?

Daily stock prices for Johnson & Johnson

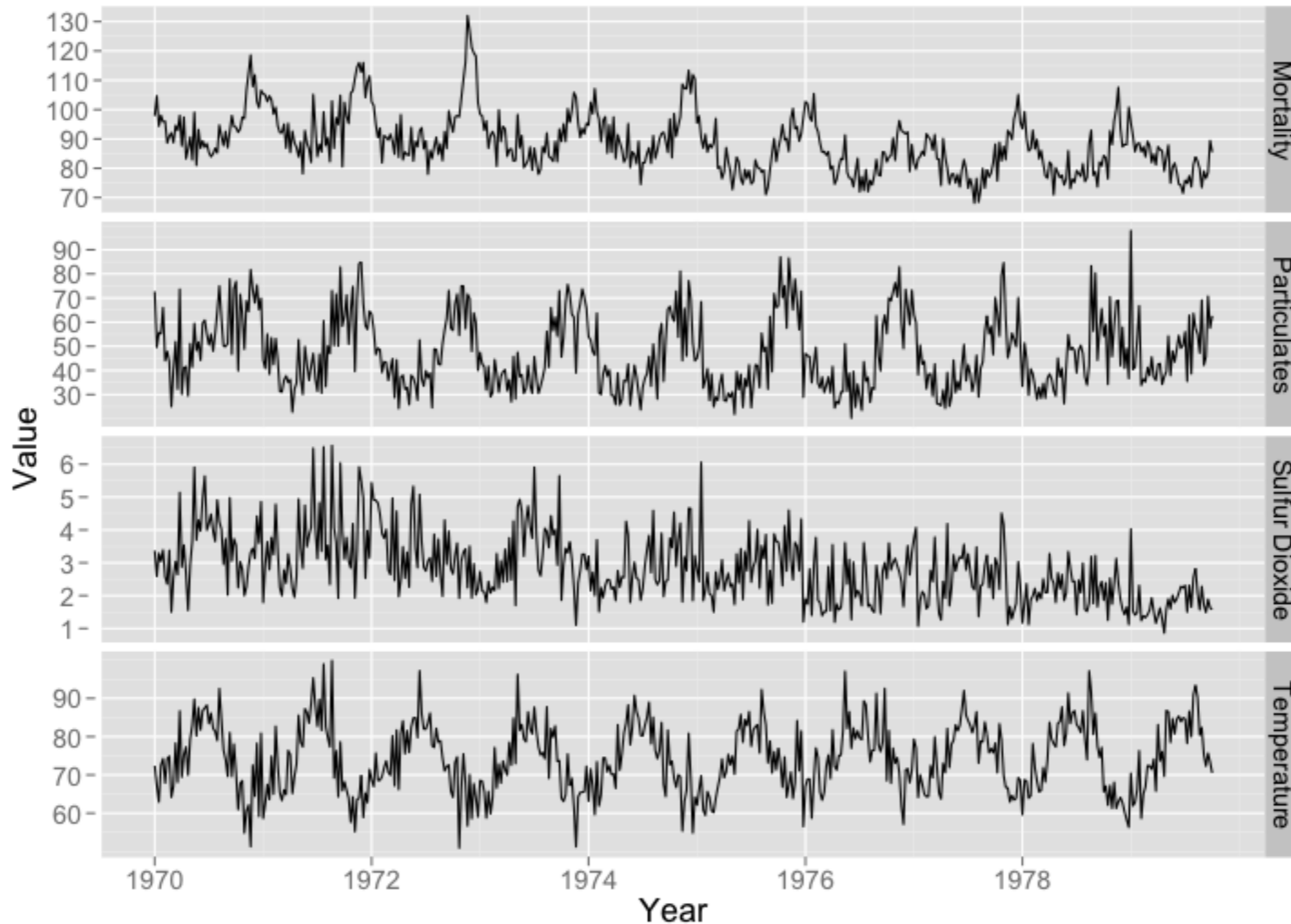


Seismograph for earthquake and explosion



How can we describe the difference?
Can we classify a series?

Weekly cardiovascular mortality in LA



Can mortality be explained by temperature or particulate matter?

ST565 plan of attack

time domain analysis

1. Exploratory data analysis for time series

2. Time series models:

Basic time series models and their properties

Fitting time series models to data

Forecasting with time series models

3. Regression with time series errors

4. Spectral Analysis frequency domain analysis

Linear Systems

State Space Models

Other topics as time permits...

the “basics”
of any time
series class

Stationarity

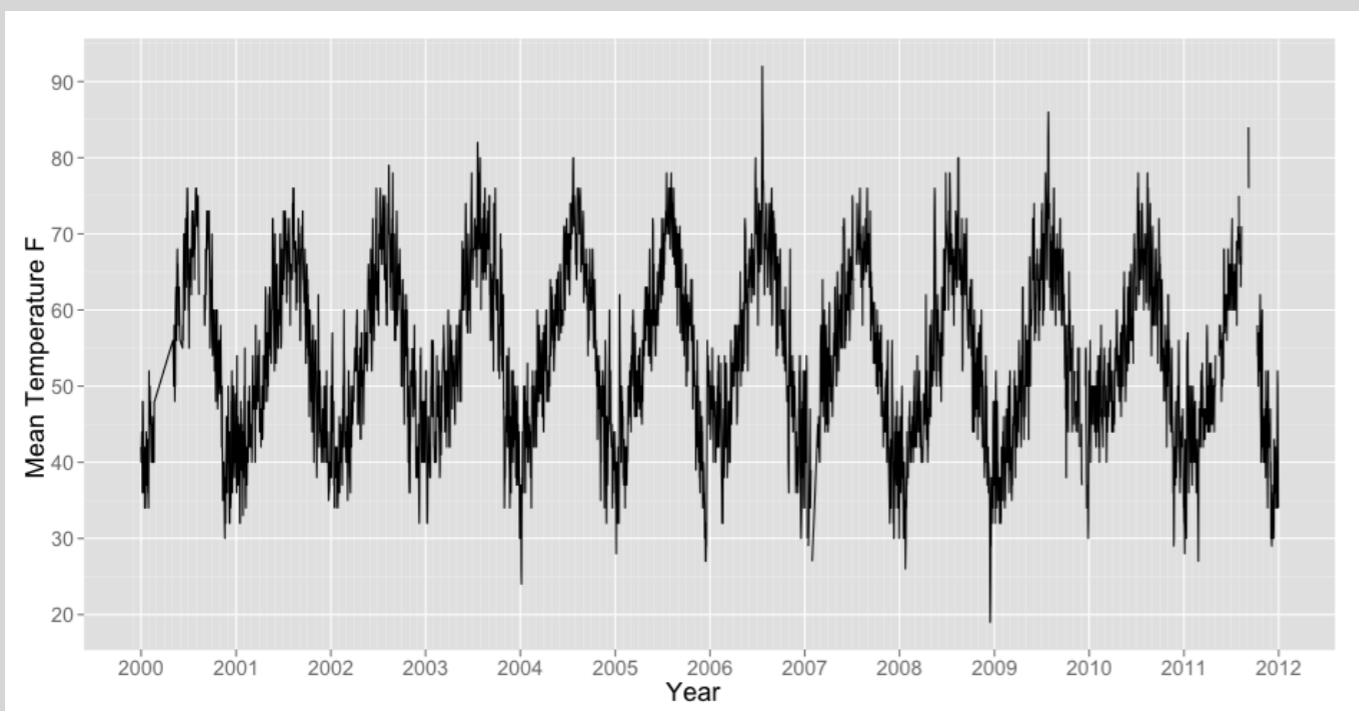
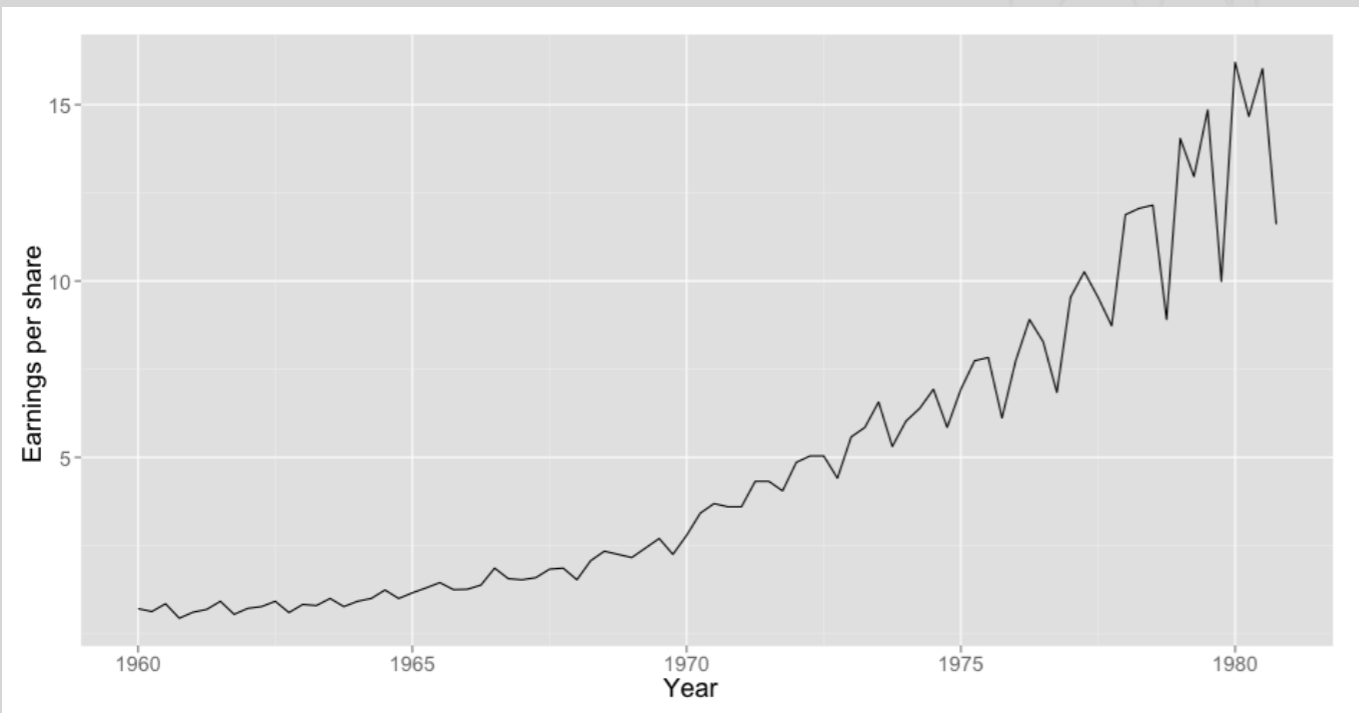
A time series is **stationary** if its statistical properties don't change through time.

(More precise definition later)

The basic idea of (time domain) time series analysis:

1. Remove or model the parts that change through time to get a stationary series.
2. Use a time series model to capture the correlation in the stationary series.
3. Combine 1. & 2. to answer questions of interest.

Your turn

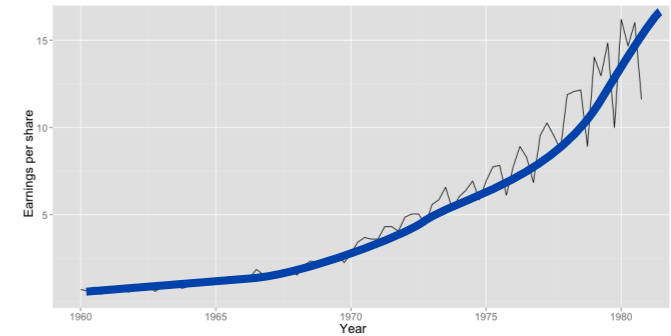


What properties of these series seem to be changing through time?

Common features of time series

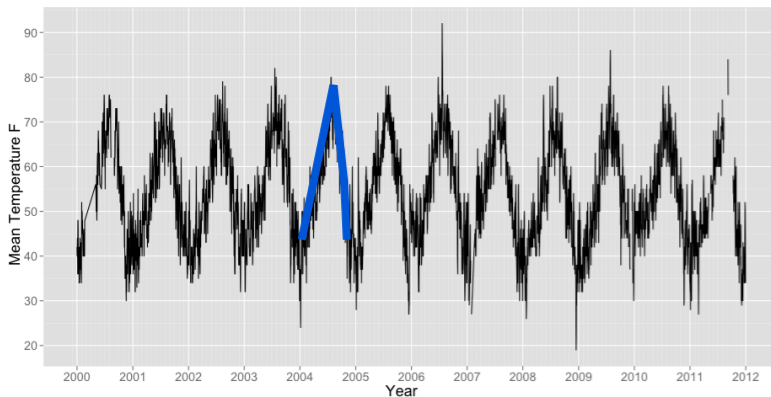
Trend

long term change in mean level



Seasonality

variation in mean that is periodic in nature (and you generally know the period beforehand)



Cycles e.g. El Nino

variation that oscillates but not according to some known or fixed period

Noise

↑
Stationary?

Exploratory Data Analysis

“Long before worrying about how to convince others, you first have to understand what’s happening yourself” – Andrew Gelman

“The greatest value of a picture is when it forces us to notice what we never expected to see.”

— John W. Tukey

Exploratory data analysis is all about understanding the structure of your data.

Be curious, be creative, be cautious (in regards to inference)

A general approach for EDA in time series

Describe and model the most obvious part

Subtract (or divide) it from the series and repeat

When there is just "noise" left, examine it's variance and correlation structure

A quick note on the `ts` class in R

R has a class for time series, `ts`

It's designed for equispaced time series and uses an index for time (as opposed to an actual date or time).

It's great if you know exactly what data you have, it's in time order, and what you want to do with it (i.e. a textbook example).

It isn't very useful for EDA, so we won't see it Thursday. We will see it throughout the quarter.

Thursday

We'll get hand's on with some time series in R:

dates and times in R

dplyr - as a tool for summarization and aggregation

ggplot2 - my plotting package of choice

Your turn

1001 1001

Bring laptop if you can

Update/install R

Install some useful packages:

```
install.packages(c("ggplot2", "dplyr",  
  "lubridate"))
```