

```

% gda03_03
%
% Ln fits of straight line to synthetic data
% done via grid search. Supports Figure 3.3.

clear all;

% auxially variable z
N=30;
zmin=0;
zmax=10;
z = sort(random('Uniform',zmin,zmax,N,1));

% linear model
% d = a + b*z + noise
a=2.0;
b=1.0;
sd=0.5;
dobs = a+b*z+random('Normal',0,sd,N,1);

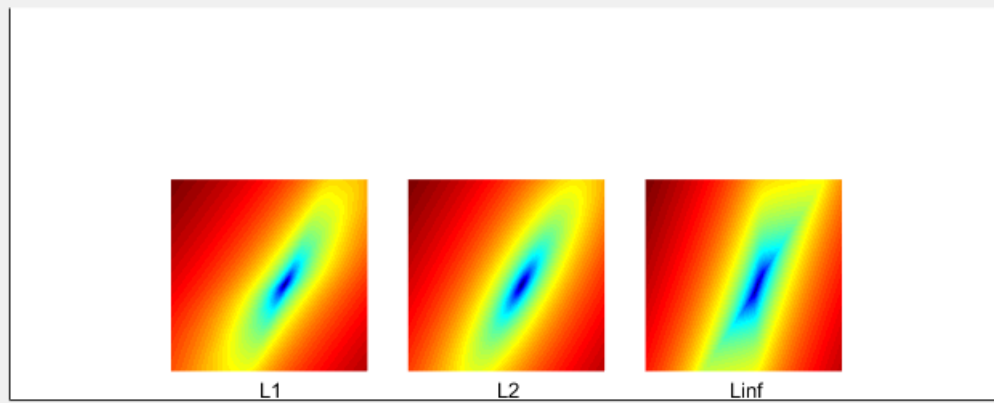
% one terrible outlier
dobs(N)=random('uniform',0,dobs(N),1,1);

% grid (a=intercept, b=slope)
Na=1001;
amin=-20;
amax=20;
Da = (amax-amin)/(Na-1);
Nb=1001;
bmin=-6;
bmax=6;
Db = (bmax-bmin)/(Nb-1);

% populate grid with errors
E1 = zeros(Na,Nb);
E2 = zeros(Na,Nb);
Einf = zeros(Na,Nb);
for i=[1:Na]
for j=[1:Nb]
    ao = amin+Da*(i-1);
    bo = bmin+Db*(j-1);
    dpre = ao + bo*z;
    e = dobs-dpre;
    abse = abs(e);
    E1(i,j)=sum(abse);
    E2(i,j)=sum(abse.^2);
    Einf(i,j)=sum(abse.^20); % cheating; using large but finite power
end
end

% Important! Examine the error surface to make sure that
% the minimum is within the grid!
gda_draw(log10(E1),'caption L1',' ',log10(E2), 'caption L2',' ',log10(Einf),'caption Linf');

```



% Figure 3.3 Error surfaces for straight line fits to (z, d) pairs where the error is measured
% under the (A) L1,(B) L2 and (C) L^∞ norms.

```
% find minimum error
```

```
[Ep, p] = min(E1);  
[E1min, c1] = min(Ep);  
r1 = p(c1);  
a1 = amin+Da*(r1-1);  
b1 = bmin+Db*(c1-1);  
dpre1 = a1 + b1*z;
```

```
[Ep, p] = min(E2);  
[E2min, c2] = min(Ep);  
r2 = p(c2);  
a2 = amin+Da*(r2-1);  
b2 = bmin+Db*(c2-1);  
dpre2 = a2 + b2*z;
```

```
[Ep, p] = min(Einf);  
[Einfmin, cinf] = min(Ep);  
rinf = p(cinf);  
ainf = amin+Da*(rinf-1);  
binf = bmin+Db*(cinf-1);  
dpreinf = ainf + binf*z;
```

```
% write our intercept & slope
```

```
disp(sprintf('1: a %f b %f', a1, b1 ));
```

```
1: a 1.920000 b 0.972000
```

```
disp(sprintf('1: a %f b %f', a2, b2 ));
```

```
1: a 2.000000 b 0.936000
```

```
disp(sprintf('1: a %f b %f', ainf, binf ));
```

```
1: a 2.880000 b 0.756000
```

```
% plot results
```

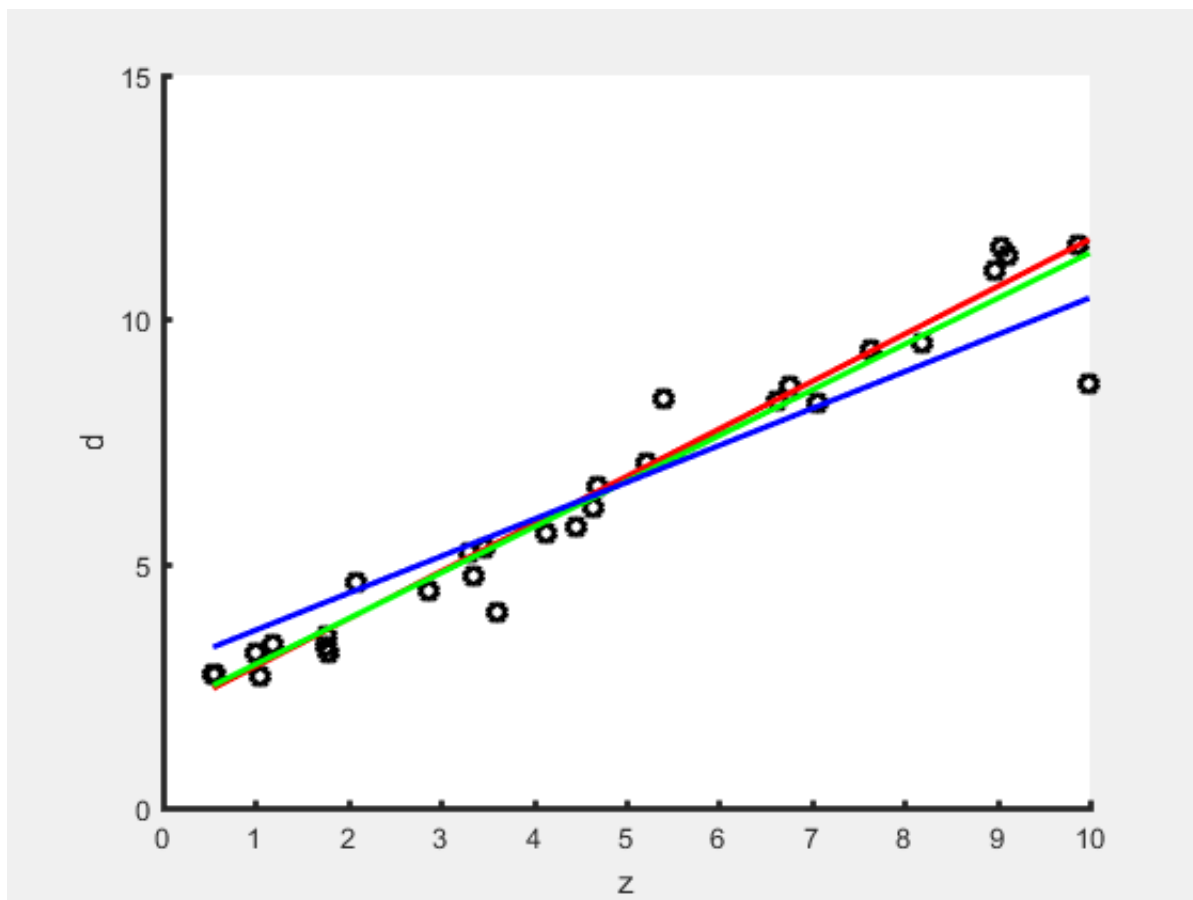
```
figure(2);  
clf;
```

```

% plot bounds
pdmin=0;
pdmax=15;

% plot data and fits
set(gca,'LineWidth',2);
hold on;
axis( [zmin, zmax, pdmin, pdmax] );
plot( z, dobs, 'ko', 'LineWidth', 2);
plot( z, dpre1, 'r-', 'LineWidth', 2);
plot( z, dpre2, 'g-', 'LineWidth', 2);
plot( z, dpreinf, 'b-', 'LineWidth', 2);
xlabel('z');
ylabel('d');

```



% Figure 3.3 Straight line fits to (z, d) pairs where the error is measured under the L1 (red)
 % L2 (green) and L^∞ (blue) norms. The L1 norm gives the least weight to the one outlier.