# ECE 341 - Homework #9

Weibull Distribution, Central Limit Theorem. Due Wednesday, June 2nd

Please make the subject "ECE 341 HW#9" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

## Weibull Distribution

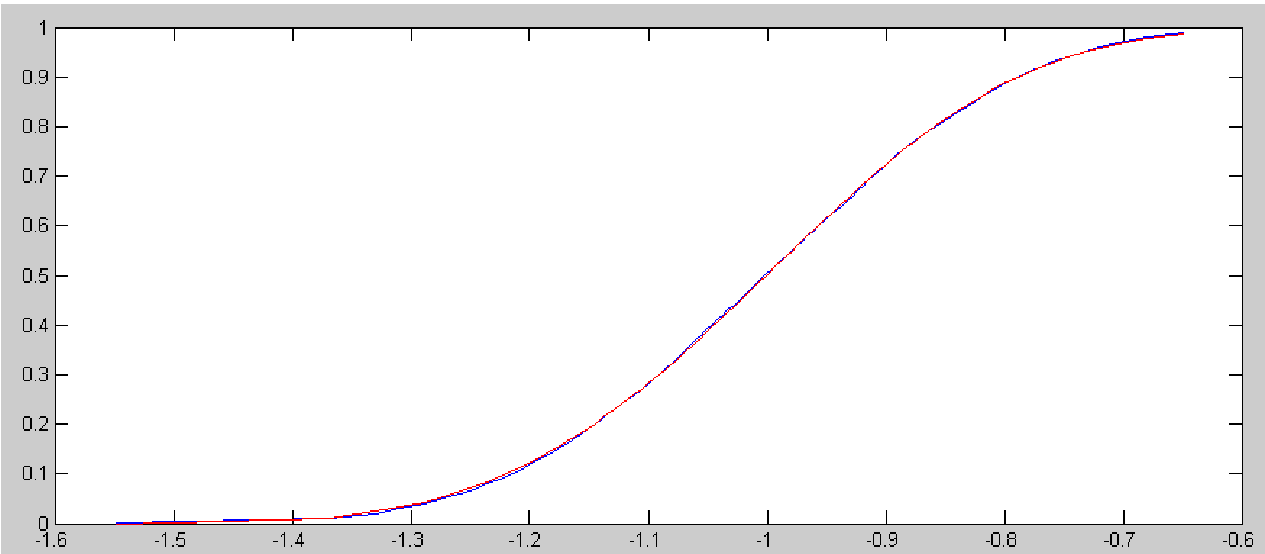
1) Determine the cdf for the voltage, V5, in homework set #7 using a Weibull approximation.

```
>> [Z,e] = fminsearch('hw9',[1,2,-3])

          k          L          X0
Z =    3.6716     0.6054    -1.5483

e =   9.6210e-004
```

X0 is shifted by -1.5483 so that the minimum value of V4 = 0. This makes X0 1.964

$$F_x(\lambda, k) = \left(1 - \exp\left(-\left(\frac{x-x_0}{\lambda}\right)^k\right)\right) u(x - x_0)$$

$$F_x(\lambda, k) = \left(1 - \exp\left(-\left(\frac{x+1.5483}{0.6054}\right)^{3.6716}\right)\right) u(x + 1.5483)$$




cdf for V4 (blue) and Weibull approximation (red)

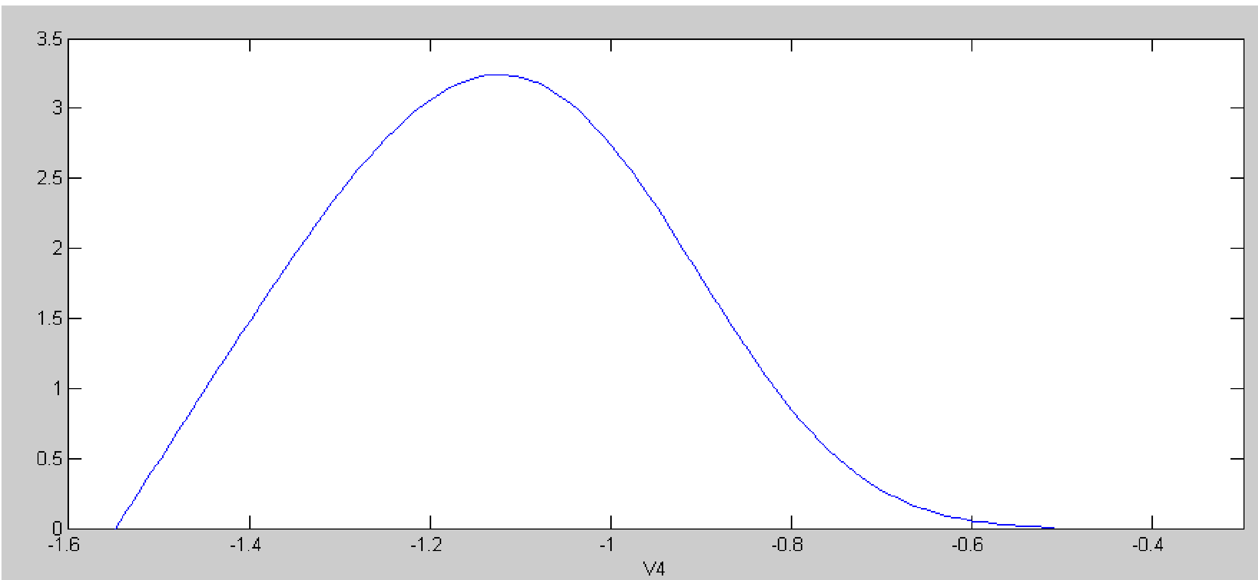
2) Determine the pdf for the votlage V4.

The pdf for a Weibull distribution is

$$f(x:\lambda,k)=\frac{k}{\lambda}\left(\frac{x-x_0}{\lambda}\right)\exp\left(-\left(\frac{x-x_0}{\lambda}\right)^k\right)u(x-x_0)$$

Plugging in the values we found

```
>> x = [x0:0.01:-0.5]';
>> f = k/L * ((x-x0)/L) .* exp(-((x-x0)/L).^k);
>> plot(x,f)
>> xlabel('V4');
>>
```




pdf for the voltage V4

## Central Limit Theorem

Let X be the sum of ten 6-sided dice (10d6 - i.e. level 10 fireball for d&d fans...).

3) Determine the probability of rolling 45 or higher with 10d6

Use Matlab with a Monte Carlo simulation with 1 million rolls:

```
Result = 0;

for n=1:1e6
   dice = sum(ceil(6*rand(10,1)));
   if(dice >= 45)
       Result = Result + 1;
   end
end

Result / 1e6

ans =     0.0388
```

4) Use a Normal approximation and from this, determine the probability that the sum is 44.5 or higher.

For a single die

- mean(d6) = 3.5
- varance(d6) = 2.9167
- std(d6) = 1.7078

For 10d6

- mean = 35
- variance = 29.167
- std = 5.4006

The z-score for 44.5 or more is

$$z = \left(\frac{35-44.5}{5.4006}\right) = -1.7591$$

p = 0.039 (from StatTrek)

There is a 3.9% chance of rolling 45 or higher

Let {a, b, c, d, e, f} be uniform distributions over the range of (0, 1).

Let X be the sum: a + b + c + d + e + f

5) Determine the probability that the sum is more than 4.2

Use Matlab along with a Monte Carlo simulation with 1 million trials

```
Result = 0;

for n=1:1e6
   X = sum(rand(6,1));
   if(X >= 4.2)
       Result = Result + 1;
   end
end

Result / 1e6

ans =    0.0451
```

*There is 4.51% chance of the sum being more than 4.2*

6) Use a Normal approximation and from this, determine the probability that the sum is more than 4.2

A single uniform distrubution has

- mean = 1/2
- variance = 1/12

Summing six uniform distributions results in

- mean = 6/2 = 3
- variance = 6/12
- standard deviation = 0.707107

The z-score for 4.5 is

$$z = \left(\frac{3-4.2}{0.707107}\right) = -1.6971$$

p = 0.045 *from StatTrek*

*There is a 4.5% chance of the sum being more than 4.2*