Homework for Lecture 10 of Dr. Z.'s Dynamical Models in Biology class

Email the answers (as .pdf file) to

ShaloshBEkhad@gmail.com

by 8:00pm Monday, Oct. 13, 2025.

Subject: hw8

with an attachment hw8FirstLast.pdf and/or hw8FirstLast.txt

Using

`http://sites.math.rutgers.edu/~zeilberg/Bio25/DMB10.txt`

1. Using procedure `ExactPD` find the probability of winning, and expected duration of the game in a Gambler's Ruin with max. capital 40 dollars, starting capital 20 dollars and prob. of winning a dollar at any one round $\frac{19}{40}$.

Now using `EstPD`, estimate it with (i) `K=100`, (ii) `K=1000` (iii) `K=5000` (Warning: this may take some time) Which of them gives the best estimate? Can you explain why?

2.

Plot `ForPD(n,100,p)[1]` from `p=0.45` to `p=0.5` for `n=10,20,30,40,50,60,70,80,90`.

1. Using procedure `ExactPD` find the probability of winning, and expected duration of the game in a Gambler's Ruin with max. capital 40 dollars, starting capital 20 dollars and prob. of winning a dollar at any one round $\frac{19}{40}$.

Now using `EstPD`, estimate it with (i) `K=100`, (ii) `K=1000` (iii) `K=5000` (Warning: this may take some time) Which of them gives the best estimate? Can you explain why?

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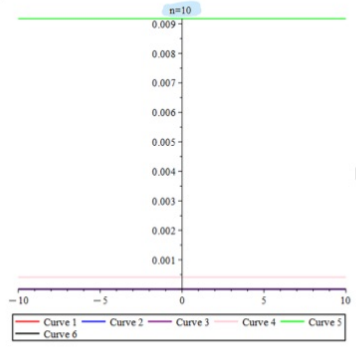
> ExactPD(20, 40, 19/40)
                                  [0.1190277811, 304.7777751]
> EstPD(20, 40, 19/40, 100)
                                  [0.1100000000, 292.0600000]
> EstPD(20, 40, 19/40, 1000)
                                  [0.1310000000, 308.3000000]
> EstPD(20, 40, 19/40, 5000)
                                  [0.1234000000, 307.1728000]
```

PROB of winning	duration
0.119	304 rds
0.110	292 rds
0.131	308 rds
0.123	307 rds

K=5000 has the best estimate b/c 0.123 ≈ 0.119 and 307 is closest to 304

PROBLEM #2

```
> P1 := plot(ForPD(10, 100, 0.45)[1], color = red) :
> P2 := plot(ForPD(10, 100, 0.46)[1], color = blue) :
> P3 := plot(ForPD(10, 100, 0.47)[1], color = purple) :
> P4 := plot(ForPD(10, 100, 0.48)[1], color = pink) :
> P5 := plot(ForPD(10, 100, 0.49)[1], color = green) :
> P6 := plot(ForPD(10, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=10")
```




```
> P1 := plot(ForPD(20, 100, 0.45)[1], color = red) :
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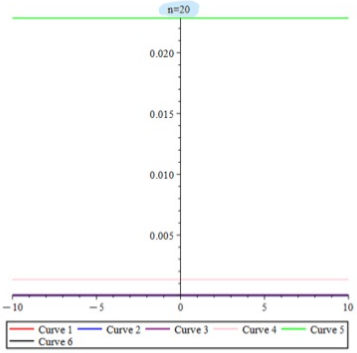
> P5 := plot(ForPD(20, 100, 0.49)[1], color = green) :
> P6 := plot(ForPD(20, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=20")
```




```
> P1 := plot(ForPD(30, 100, 0.45)[1], color = red) :
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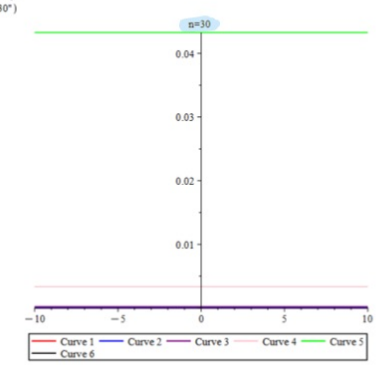
> P6 := plot(ForPD(30, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=30")
```




```
> P1 := plot(ForPD(40, 100, 0.45)[1], color = red) :
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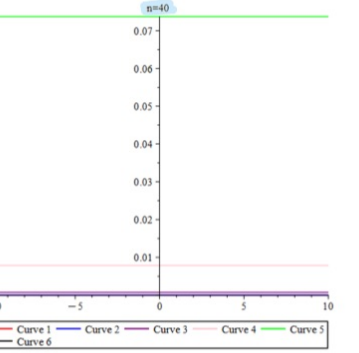
> P4 := plot(ForPD(40, 100, 0.48)[1], color = pink) :
> P5 := plot(ForPD(40, 100, 0.49)[1], color = green) :
> P6 := plot(ForPD(40, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=40")
```



```
> P1 := plot(ForPD(50, 100, 0.45)[1], color = red) :
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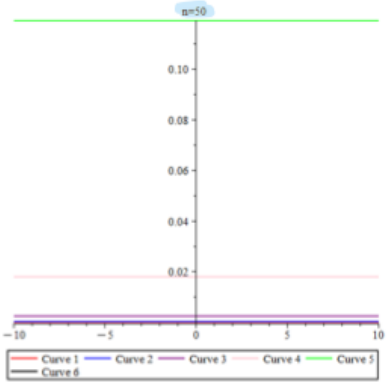
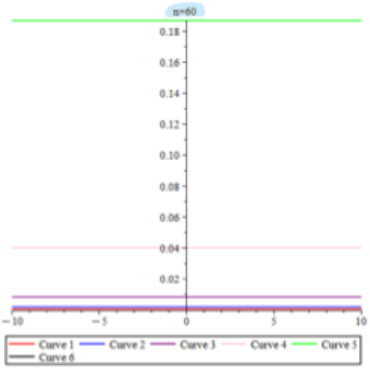
> P5 := plot(ForPD(50, 100, 0.49)[1], color = green) :
> P6 := plot(ForPD(50, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=50")
```




```
> P1 := plot(ForPD(60, 100, 0.45)[1], color = red) :
> P2 := plot(ForPD(60, 100, 0.46)[1], color = blue) :
> P3 := plot(ForPD(60, 100, 0.47)[1], color = purple) :
> P4 := plot(ForPD(60, 100, 0.48)[1], color = pink) :
> P5 := plot(ForPD(60, 100, 0.49)[1], color = green) :
> P6 := plot(ForPD(60, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=60")
```




```
> P1 := plot(ForPD(70, 100, 0.45)[1], color = red) :
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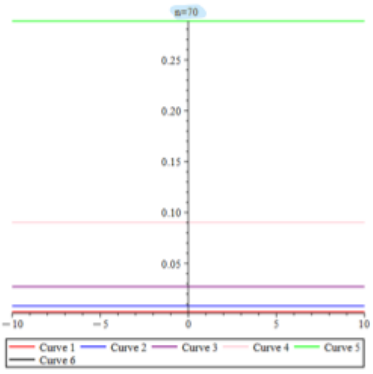
> P6 := plot(ForPD(70, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=70")
```




```
> P1 := plot(ForPD(80, 100, 0.45)[1], color = red) :
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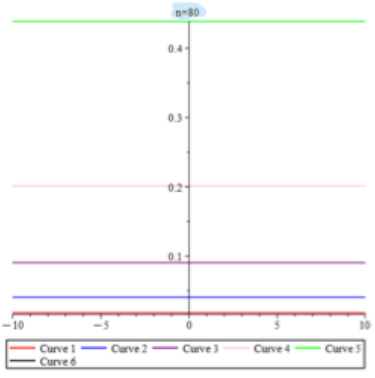
> P6 := plot(ForPD(80, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=80")
```

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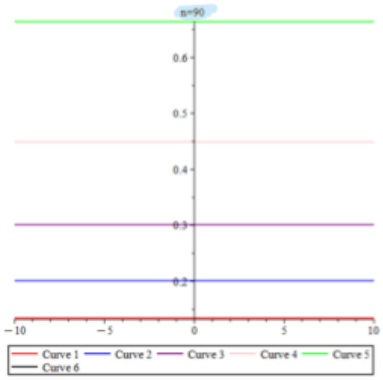
> P6 := plot(ForPD(90, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=90")
```



1. Using procedure `ExactPD` find the probability of winning, and expected duration of the game in a Gambler's Ruin with max. capital 40 dollars, starting capital 20 dollars and prob. of winning a dollar at any one round $\frac{19}{40}$.

Now using `EstPD`, estimate it with (i) `K=100`, (ii) `K=1000` (iii) `K=5000` (Warning: this may take some time) Which of them gives the best estimate? Can you explain why?

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```

prob of winning: 0.119 Duration: 304 rds

prob of winning: 0.110 Duration: 292 rds

prob of winning: 0.131 Duration: 308 rds

prob of winning: 0.123 Duration: 307 rds

K=5000 has the best estimate bc 0.123 ≈ 0.119 and 307 is closest to 304.

2.

Plot `ForPD(n,100,p)[1]` from `p=0.45` to `p=0.5` for `n=10,20,30,40,50,60,70,80,90`.

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> P1 := plot(ForPD(10, 100, 0.45)[1], color = red) :
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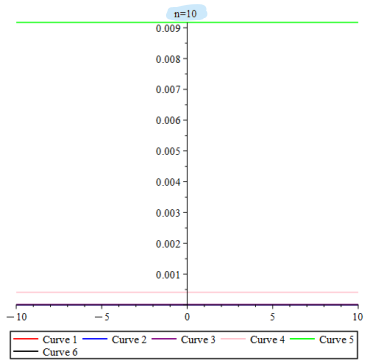


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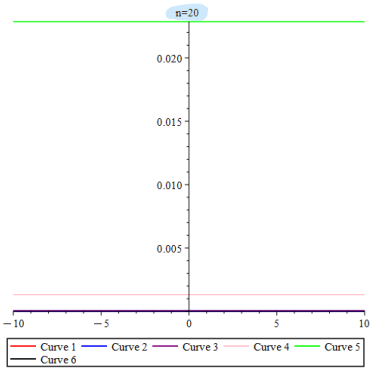


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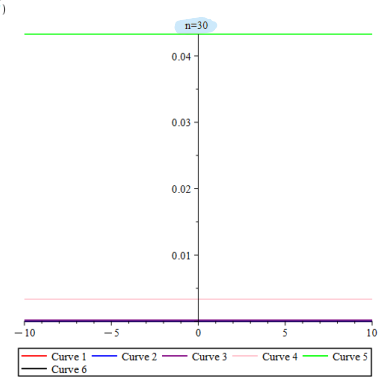


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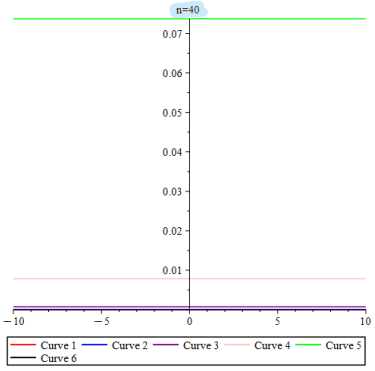

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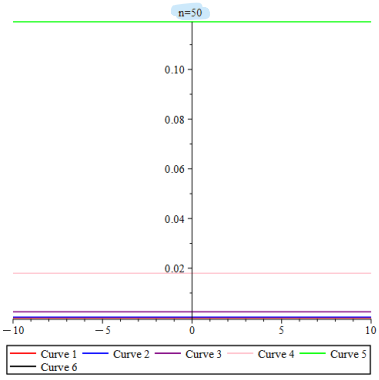
```

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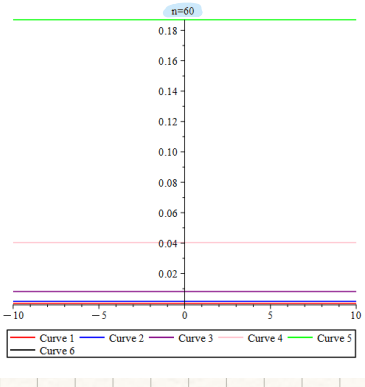


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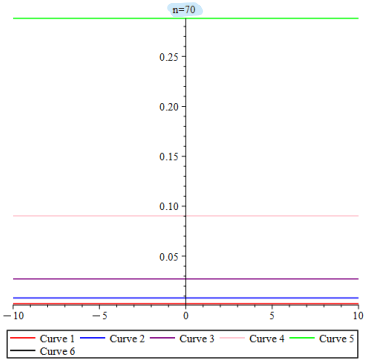
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=70")
```

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> P1 := plot(ForPD(80, 100, 0.45)[1], color = red) :
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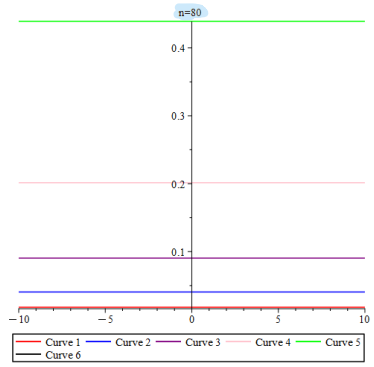
> P6 := plot(ForPD(80, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=80")
```

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> P6 := plot(ForPD(90, 100, 0.5)[1], color = black) :
> plots:-display(P1, P2, P3, P4, P5, P6, title = "n=90")
```