

**William Liaw**

**Your title goes here**

Thesis submitted for the degree of Master of  
Science to the School of Engineering.

Palaiseau  
2024

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Thesis submitted for the degree of Master of  
Science to the School of Engineering.

Concentration Field:  
Systems Engineering (example)

Advisor:  
Prof. Dr. advisor name

Palaiseau  
2024

To my family

## **ACKNOWLEDGMENT**

I thank all the people who...

## SUMMARY

In this work, we study the...

**Keywords:** Stochastic control. Linear systems. Optimal control. Maximum variance. Portfolio optimization.

## ABSTRACT

In this work we study the...

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## LIST OF SYMBOLS

$\Delta(h)$  Assinatura diádica

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## 1 INTRODUCTION

Here you should give the context, justifications...

Do yourself a favor and follow the structure guidelines in the file `Research structure guidelines.md`. It should make your life easier.

In this template I will leave examples on how to cite, reference chapters, tables, figures, use math symbols along the text, write equations, label them for further referencing, use cases in equations, write tables, include figures, use special math formatting and symbols, use proof environments for theorems, matrix environments, etc. Remember to build the main file *thesis\_main.tex* to visualize the updated pdf.

Example of how to reference a chapter: This dissertation is structured in... chapters. In Chapter 2 we present a ...

[Rami et al., 2001]

## **2 LITERATURE REVIEW**

### **3     METHODOLOGY**

Introduction here...

## 4 RESULTS

## **5 CONCLUSION**

In this work we have considered ...

## REFERENCES

- [Rami et al., 2001] Rami, M. A., Chen, X., Moore, J. B., and Zhou, X. Y. (2001). Solvability and asymptotic behavior of generalized riccati equations arising in indefinite stochastic lq controls. *IEEE Transactions on Automatic Control*, 46:428–440.



## A NUMERICAL DATA OF SIMULATIONS

Example of long tables that cross pages.

Table 1: System's output for all scenarios.

Time	Scenario 1	Scenario 2	Scenario 3	Scenario 4
1	1.3	1.2	1.1	1.0
2	2.4	1.9	1.6	1.0
3	3.7	2.8	2.1	1.1
4	5.2	3.7	2.7	1.2
5	6.7	4.7	3.4	1.2
6	8.2	5.7	4.0	1.3
7	9.7	6.7	4.6	1.3
8	11.1	7.6	5.2	1.4
9	12.4	8.4	5.7	1.4
10	13.6	9.2	6.2	1.4
11	14.7	9.9	6.7	1.5
12	15.7	10.6	7.1	1.5
13	16.7	11.2	7.5	1.5
14	17.5	11.7	7.8	1.5
15	18.3	12.2	8.1	1.6
16	18.9	12.7	8.4	1.6
17	19.5	13.1	8.6	1.6
18	20.0	13.4	8.9	1.6
19	20.5	13.7	9.0	1.6
20	20.9	13.9	9.2	1.6

Source: Author.

Table 2: System's output variance for all scenarios.

Time	Scenario 1	Scenario 2	Scenario 3	Scenario 4
1	0.86	0.37	0.15	0.0007
Continued on next page				

Time	Scenario 1	Scenario 2	Scenario 3	Scenario 4
2	3.54	1.50	0.60	0.003
3	6.19	2.62	1.05	0.005
4	8.25	3.49	1.40	0.007
5	9.58	4.05	1.62	0.008
6	10.21	4.32	1.73	0.009
7	10.30	4.36	1.74	0.009
8	9.97	4.22	1.69	0.008
9	9.37	3.96	1.58	0.008
10	8.58	3.63	1.45	0.007
11	7.70	3.25	1.30	0.007
12	6.78	2.87	1.15	0.006
13	5.87	2.48	0.99	0.005
14	5.01	2.12	0.85	0.004
15	4.20	1.78	0.71	0.004
16	3.48	1.47	0.59	0.003
17	2.84	1.20	0.48	0.002
18	2.28	0.97	0.39	0.002
19	1.81	0.77	0.31	0.002
20	1.42	0.60	0.24	0.001

Source: Author.

Table 3: Control policy for scenario A.

Time	CDI	EMBR3	ITUB4	PETR4	VALE5
0	-137.9	-24.9	87.1	9.8	66.9
1	-138.7	-21.8	88.5	15.5	57.8
2	-136.0	-20.0	87.3	17.4	53.6
3	-126.9	-18.2	82.3	17.4	49.1
4	-116.2	-16.5	76.4	17.0	44.5
5	-109.6	-15.5	72.9	16.3	42.6
6	-100.9	-14.3	68.3	15.6	39.6
7	-94.8	-13.3	65.1	14.8	37.8
8	-87.0	-12.0	60.9	14.2	35.0
9	-73.2	-11.0	53.5	12.5	30.6

Continued on next page

Time	CDI	EMBR3	ITUB4	PETR4	VALE5
10	-65.9	-10.0	49.4	11.5	28.5
11	-51.4	-9.2	41.5	9.6	24.2
12	-43.2	-8.4	37.0	8.3	22.0
13	-37.8	-7.2	34.1	7.9	19.7
14	-29.9	-6.4	29.7	6.9	17.2
15	-23.2	-5.4	25.9	6.1	14.8
16	-16.6	-4.6	22.2	5.2	12.8
17	-12.7	-3.9	20.0	4.7	11.4
18	-7.0	-3.3	16.8	3.9	9.7
19	-1.6	-2.7	13.7	3.3	7.7

Source: Author.

Table 4: Control policy for scenario B.

Time	CDI	EMBR3	ITUB4	PETR4	VALE5
0	-89.3	-16.2	56.6	6.4	43.5
1	-89.3	-14.0	57.2	10.2	37.1
2	-85.8	-12.9	55.4	11.0	34.2
3	-80.5	-11.8	52.6	11.1	31.5
4	-76.7	-11.1	50.5	11.0	30.0
5	-74.3	-10.3	49.4	11.0	28.9
6	-63.1	-9.4	43.2	9.7	25.4
7	-57.4	-8.6	40.2	9.2	23.3
8	-50.3	-7.9	36.3	8.4	21.1
9	-45.8	-7.2	33.9	7.9	19.5
10	-38.0	-6.6	29.6	6.7	17.4
11	-35.3	-5.8	28.2	6.6	16.3
12	-29.3	-5.3	25.0	5.8	14.4
13	-24.1	-4.6	22.0	5.2	12.7
14	-19.0	-4.2	19.2	4.3	11.4
15	-14.9	-3.6	17.0	3.9	9.9
16	-10.5	-3.1	14.4	3.3	8.5
17	-7.1	-2.6	12.6	3.0	7.2
18	-4.4	-2.1	11.0	2.6	6.2

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Time	CDI	EMBR3	ITUB4	PETR4	VALE5
19	-0.3	-1.7	8.7	2.1	4.9

Source: Author.