TEACHING-LEARNING CONTRACT

LEARNING PROGRAM OUTLINE

LEARNING UNIT PROGRAM

STOCHASTIC PROCESSES

PAS 132

STATISTICS STUDY PROGRAM OF MATHEMATICS DEPARTMENT
MATHEMATICS AND SCIENCE FACULTY
DIPONEGORO UNIVERSITY
SEMARANG
2007

STUDYING CONTRACT

Course Name	**: STOCHASTIC PROCESSES**
Course Code	**: PAS 132**
SCU	**: 3 SCU**
Semester	**: VII**

1. Course Advantage

This course is applied course of mathematical statistics which is course of statistics theory determined by mathematics. Whereas studying method use estimation by probability. The materials were processes of statistics type on life together. In live together there are much event which is making process things follow time either discrete or continuous type. The teaching to student done by theory and practice. The student hoped can know, make and solve that processes to event of stochastic processese type. So that students in studying can able to absorb and apply this science by well in them life. Other advantage use to students at other time on learning mathematics, especially on statistics. The estimated advantage are students able to know and solve cases of Poisson processes, renewal theory, Markov chain whereas discrete or cotinuous, Martingales, and random walks, finally Brownian motion.

2. Course Description

This course is advanced course of probability and mathematical statistics which scope talking follow on time that are both discrete and continuous time. The materials of both courses is used to applying on stochastic processes couse. The course consist of Poisson processes, renewal theory, Markov chain, martingales, random walks, and Brownian motion. This materials hoped students could able built themselves to solve stochastic processes or maybe course other relation by so on.

3. Instructional Objective

General Instructional Objective:

After follow this course, the students expected able to know Poisson processes, renewal theory; use Markov chain whereas discrete or cntinuous; see martingales, random walks; apply Brownian motion to ecomonics.

Special Instructional objectives:

After follow this course, the students hoped able to:

1. Know Poisson processes.
2. See renewal theory.
3. Use Markov chain discrete time.
4. Use Markov chain continuous time.
5. Estimate to use martingales.
6. Solve random walks.
7. Apply Brownian motion.
8. See advanced Markov processes.

4. Lecture Strategic

Lecture method use presentation with solve problem, task and practise. Presentation done by lecture modul. Solve problem done to absorb material well, whereas the task is given by scheduled on last lecture for the subject. The task has been given, collected on meeting other time, that result wil be retuned to students for correction themselves. Well, other time done discussion about the task. The students hoped talk active in lecture or discussion, so they could absorb that material by good and true. Other thing to know by practically done by practise and so by computation can make program and see relevan software. General aims, in order to students see by theory and counting. Then on other time used to add capable building themselves by theory and practise at science forum so on.

5. Reference

The text books recommended are:

1. Kurkani, V.G., *Modeling, Analysis, Design, and Control of Stochastic Systems*, Springer-Verlag, New York,1999.
2. Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.
3. Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.
4. Winston, W.L., Operations Research: *Applications and Algorithms*, PWS-KENT Publishing Company, Boston, 1987.

6. Task and Practice

The task is given by:

Task I is given with individual, after first a half of material had been studied. Task submiting was done on tomorrow meeting. **Task result I** had been corrected will be return to students as feed back about material absorbing.

Tasl II is given with individual, after last a half of material had been studied. Task submitting was done on tomorrow meeting. **Task result II** had been corrected will be return to students as feed back about material absorbing.

The practice was given by:

The practice was done in Statistics Laboratory with present 5 times and 1 time to use response. The other hand, students must make practice result report by individual as practice complete conditional.

7. Scoring Criteria

Scoring will be done by lecturer with use condition as follow:

Grade	Point	Range
A	4	$87,5 < x \leq 100$
AB	3,5	$75 < x \leq 87,5$
B	3	$62,5 < x \leq 75$
BC	2,5	$50 < x \leq 62,5$
C	2	

CD	1,5	$37,5 < x \leq 50$
D	1	$25 < x \leq 37,5$
E	0	$12,5 < x \leq 25$
		$0 < x \leq 12,5$

On determine final value will be used weight as follow:

Task	:	10 %
Practice	:	20 %
Midsemester Exam	:	35 %
Semester Final Exam	:	35 %

8. Meeting Schedule

Week	Scope Topics	Reference
1	1. Meeting Contract 2. Probability, Random Variable and Expected Value	[1], [2], and [3]
2	3. Limit Theorem 4. Stochastic Processes Definition	[1], [2], [3] and [4]
3	5. Poisson Processes Meaning 6. Nonhomogeneous Poisson Process	[1], [2], and [3]
4	7. Compund Poisson Processes 8. Conditional Poisson Processes 9. Task I	[1], [2], and [3]
5	10. Distribution of N(t) 11. Wald's Equation 12. Problem Solving	[2] and [3]
6	13. Renewal Theory Applications 14. Delayed and Reward Renewal Processes	[2] and [3]
7	15. Regenerative Processes	

	16. Stationary Point Processes 17. Problem Solving	[2] and [3]
8	**Midsemester Exam**	
9	18. Chapman-Kolmogorov Equations 19. Branching Processes	[1], [2], [3] and [4]
10	20. Markov Chains Appilcations	[1], [2], [3] and [4]
11	21. Continuous-Time Markov Chains 22. Problem Solving	[1], [2], and [3]
12	23. Martingales 24. Task II	[3]
13	25. Random Walks 26. Using Martingales to Random Walks	[3]
14	27. Variations on Brownian Motion 28. Brownian Motion with Drift	[2] and [3]
15	29. Diffusion Equations 30. Stationary Processes	[3]
16	31. Doing Task 32. Problem Solving	
Scheduled	**Semester Final Exam**	

LEARNING PROGRAM UNIT

COURSE	**: STOCHASTIC PROCESSES**
COURSE CODE	**: PAS 132**
SCU	**: 3**
DURATION	**: 3 x 50 minutes**
MEETING	**: 1**

A. Instructional Objectives

1. **General:**

   After studying this course, the students see learning contract which will be done and talked the material.

2. **Specific:**

   After follow this course, the students could know learning contract and able to see probability, random variable and expected values.

B. Subjects:

- Learning Contract
- Probability and Expected Value

C. Sub Subjects:

- Studying System
- Probability
- Expected Value

D. Teaching-Learning Activities:

Activity Stage	Lecturer Activities	Student Activities	Learning Media
Introduction	1. Give learning contract would be done 2. Explain material contains 3. Explain advantage to study probability and random variable	Seeing and writing	1. OHP 2. Transparancy 3. White Board 4. Modul
Presentation	4. Describe studying sistem and grading. 5. Describe definition of probability 6. Explain the expected value 7. Give examples topics, respectively 8. Ask to students about random variables as feed back learning	Seeing and asking	1. OHP 2. Transparancy 3. White Board 4. Modul
Closing	9. Conclude all material had been given in this meeting 10. Get general graph about material to the next meeting 11. Get comment about good study	Seeing, writing and asking	White Board

E. Evaluation : ---

F. Reference :

1 Kurkani, V.G., *Modeling, Analysis, Design, and Control of Stochastic Systems*, Springer-Verlag, New York,1999.

2 Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.

3 Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.

LEARNING PROGRAM UNIT

COURSE	**: STOCHASTIC PROCESSES**
COUSE CODE	**: PAS 132**
SCU	**: 3**
DURATION	**: 9 x 50 minutes**
MEETING	**: 2, 3 and 4**

A. Instructional Objectives

1. **General:**

   After study this course, the students could explain meaning of stochastic processes and Poison processes.

2. **Specific:**

   After follow this meeting, the students could say the definition stochastic, Poisson and compound Poisson processes.

B. Subjects:

- Stochastic Processes
- Poisson Processes
- Compound Poisson Processes

C. Sub Subjects:

- Stochastic Processes Definition
- Poisson Processes Definition
- Nonhomogeneous Poisson Processes
- Compound Poisson Processes
- Conditional Poisson Processes

D. Teaching-Learning Activities:

Activity Stage	Lecturer Activities	Student Activities	Learning Media
Introduction	1. Explain the material will be said 2. Restudy the matter ago to remember 3. Determine examples of stochastic and Poisson processes in real problems	Watching and writing	1. OHP 2. Transparancy 3. White Board 4. Modul
Presentation	4. Explain stochastic processes 5. Explain Nonhomogeneous Poisson processes 6. Apply compound Poisson processes 7. Determine conditional Poisson processes 8. Give examples of the materials, respectively 9. Ask to the students about Poisson and compound Poisson processes as feed back	Watching and asking	1. OHP 2. Transparancy 3. White Board 4. Modul
Closing	10. Conclude all maretials have been given 11. Inform the next matter for meeting tomorrow	Seeing, writing and asking	White Board

E. Evaluation : Give exercises and Task I for doing.

F. Reference :

1. Kurkani, V.G., *Modeling, Analysis, Design, and Control of Stochastic Systems*, Springer-Verlag, New York,1999.
2. Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.
3. Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.
4. Winston, W.L., Operations Research: *Applications and Algorithms*, PWS-KENT Publishing Company, Boston, 1987.

LEARNING PROGRAM UNIT

COURSE	**: STOCHASTIC PROCESSES**
COURSE CODE	**: PAS 132**
SCU	**: 3**
DURATION	**: 9 x 50 minutes**
MEETING	**: 5, 6 and 7**

A. Instructional Objectives

1. **General:**

   After finish this course, the students are able to know N(t) distribution, use renewal theory and stationary point processes.

2. **Specific:**

   After follow this meeting, the students are able to determine and apply delayed renewal processes, renewal reward processes and regenerative processes.

B. Subjects:

- Distribution of N(t)
- Applications of Renewal Theory
- Stationary Point Processes

C. Sub Subjects:

- Wald's Equation
- Delayed Renewal Processes
- Renewal Reward Processes
- Regenerative Processes
- Stationary Point Processes

D. Teaching-Learning Activities:

Activity Stage	Lecturer Activities	Student Avtivities	Learning Media
Introduction	1. remind matter by short with last meeting 2. Explain the matter would be done 3. Get chance asking, if there is a matter problem	Seeing and writing	1. OHP 2. Transparancy 3. White Board 4. Modul
Presentation	4. Define distributon of N(t) 5. Determine meaning of Wld's equation 6. Count and use renewal theory 7. Give example of the subjects, respectively 8. Ask to students about the matter as feed back 9. Get problems solving for good absorbing of the materials	Listening, watching and discussion	1. OHP 2. Transparancy 3. White Board 4. Modul
Closing	10. Conclude all of the material have been given 11. Give critic and propose studying result 12. Give information about midsemester exam	Listening, writing and discussion	White Board

E. Evaluation : Problem Solving and Discussion.

F. Reference :

1. Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.
2. Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.

LEARNING PROGRAM UNIT

COURSE	**: STOCHASTIC PROCESSES**
COURSE CODE	**: PAS 132**
SCU	**: 3**
DURATION	**: 12 x 50 minutes**
MEETING	**: 9, 10, 11 and 12**

A. Instructional Objectives

1. **General:**

   After finish the course, the students could see Chapman-Kolmogorov equation, descrete and continuous-time Markov chains, and martingales.

2. **Specific:**

   After present this meeting, the students are able to prove Chapman-Kolmogororv equation, count branching processes, apply descrete and continuous- time Markov chain, and estimate using martingales.

B. Subjects:

- Chapman-Kolmogorov Equation
- Branching Processes
- Markov Chains
- Martingales

C. Sub Subjects:

- Introduction and Examples
- Classification of State
- Limit Theorems
- Applications of Markov Chains

D. Teaching-Learning Activities:

Activity Stage	Lecturer Activities	Student Activities	Learning Media
Introduction	1. Short solve midsemester exam 2. recall important matter on study ago 3. Explain the matter which will be discusssion 4. Give ask time, if there is absorbing materials	Watching and writing	1. OHP 2. Transparancy 3. White Board 4. Modul
Presentation	5. Describe meaning transition probability matrix 6. Use limit theory 7. Describe descrete Markov chains 8. Explain continuous Markov chains 9. Observe prediction by martingales 10. Ask to students as feed back	Seeing, asking and discussion	1. OHP 2. Transparancy 3. White Board 4. Modul
Closing	11. Conclude the matter had been given 12. Give motivition about good learning	Following, writing and discussion	White Board

E. Evaluation : Problem Solving and Task II.

F. Reference :

1. Kurkani, V.G., *Modeling, Analysis, Design, and Control of Stochastic Systems*, Springer-Verlag, New York,1999.
2. Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.
3. Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.
4. Winston, W.L., Operations Research: *Applications and Algorithms*, PWS-KENT Publishing Company, Boston, 1987.

LEARNING PROGRAM UNIT

COURSE	**: STOCHASTIC PROCESSES**
COURSE CODE	**: PAS 132**
SCU	**: 3**
DURATION	**: 12 x 50 minutes**
MEETING	**: 13, 14, 15 and 16**

A. Instructional Objectives

1. **General:**

   After study this course, expected the students could use martingale on random walks and know Brown motion.

2. **Specific:**

   After finish this course, expected the students are able to apply martingales and Brown motion, and know meaning stationary processes.

B. Subjects:

- Application of Martingales on Random Walks
- Brownian Motion with Drift
- Stationary Processes

C. Subsubjects:

- Random Walks
- Variation on Brownian Motion
- Backward Diffusion Equation
- Forward Diffusion Equation
- Problem Solving

D. Teaching-Learning Activities:

Activity Stage	Lecturer Activities	Student Activities	Learning Media
Introduction	1. Give ask about question 2. Determine concern subject 3. see develop student learning	See and writing	1. OHP 2. Transparancy 3. White Board 4. Modul
Presentation	4. Explain random walks definition 5. Explain Brownian motion 6. Explain stationary processes 7. Dicus given task 8. Doing discussion and exercise probems 9. Give question to student as feed back	See, ask and discussion	1. OHP 2. Transparancy 3. White Board 4. Modul
Closing	10. Conclude given materials 11. Motivate students in order to good mterial absorbing 12. Give information about semester final test	Concern, writing and discussion	White Board

E. Evaluation : Discussion, Solve Task and Exercises.

F. References :

1. Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.
2. Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.

TEACHING PROGRAM OUTLINE

COURSE TITLE : STOCHASTIC PROCESSES

CODE NUMBER / SCU : PAS 132 / 3

SHORT DESCRIPTION :

This course is advanced of probability and mathematical statistics which domain by descrete and continuous time. The sources subject from two that courses is basic tools to apply stochastic processes. The materials of learn are Poisson processes, renewal theory, Markov chains, martingales, random walks, and Brownian motion. These materials expected students could buildself for study stochastic forever.

GENERAL INSTRUCSIONAL OBJECTIVES:

After study this course, the students hoped able to know stochastic processes, use Poisson and renewal processes; apply Markov processes with both discrete and continuous time; use martingales on random walks; analyze and apply Brownian motion, define stationari processes, too.

Nu.	Specific Instructional Objectives	Subject Core	Sub Subject Core	Est. Time	Reference
1	2	3	4	5	6
1.	Students know the study contract and expected value	Study Contract Expected Value	a. Study Contract b. Probability and Random Variable	150	[1], [2], and [3]
2.	Students could explain meaning of stochastic processes	Stochastic Processes	a. Limit Theorem b. Definition Stochastic Processes	150	[1], [2], [3] and [4]
3.	Students hoped able to explain Poisson processes	Poisson Processes	a. Poisson Processes b. Conditional Poisson Processes	150	[1], [2], and [3]
4.	Students hoped could use compound Poisson processes	Compound Poisson Processes	a. Compound Poisson Processes b. Conditional Poisson Proceses	150	[1], [2], and [3]
5.	Students could define distribution of N(t)	Counting Processes	a. Distribution of N(t) b. Wald Equation	150	[2] and [3]
6.	Students capable to use renewal theory and its processes	Application of Renewal Theory	a. Delayed Renewal Processes b. Renewal Reward Proceses	150	[2] and [3]

7.	Students can apply stationary point processes	Stationary Point Processes	Regenarative Processes	150	[2] and [3]
8.	Students expected could define branching processes	Chapman-Kolmogorov Equation	a. Chapman-Kolmogorov Equation b. Branching Processes	150	[1], [2], [3] and [4]
9.	Students could use Markov chains	Markov Chains	Application of Descrete Markov Chains	150	[1], [2], [3] and [4]
10.	Students could apply continuous Markov chains	Continuous Markov Chains	Application of Continuous Markov Chains	150	[1], [2], and [3]
11.	Students hoped could estimate by martingales	Martingales	Application of Martingales	150	[3]
12.	Students able to analyze random walks	Random Walks	a. Random Walks b. Application of Martingales to Random Walks	150	[3]
13.	Students capable compare variations on Brownian motion	Brownian Motion	a. Variations on Brownian Motion b. Brownian Motion with Drift	150	[2] and [3]
14.	Students hoped could know stationary processes	Stationary Processes	a. Diffusion Equations b. Stationary Processes	150	[3]
15.	Students could discuss to do the problems	Discussion	Discussion Task and Excercises	150	Modul

REFERENCES:

1. Kurkani, V.G., *Modeling, Analysis, Design, and Control of Stochastic Systems*, Springer-Verlag, New York,1999.
2. Ross, S.M., *Introduction to Probability Models*, Sixth Edition, Academic Press, New York, 1997.
3. Ross, S.M., *Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., New York, 1996.
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